



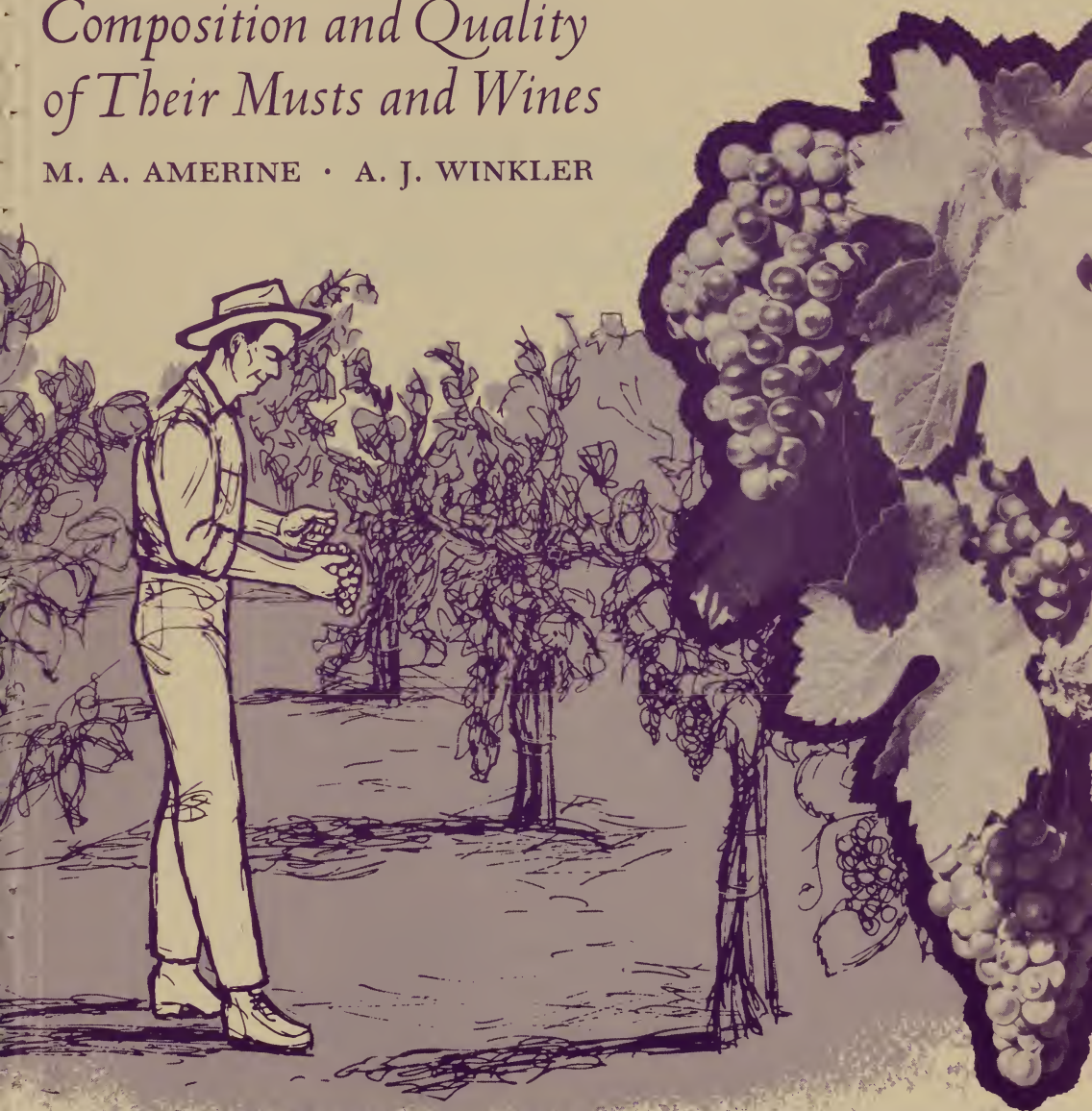
Division of Agricultural Sciences

UNIVERSITY OF CALIFORNIA

# CALIFORNIA WINE GRAPES:

*Composition and Quality  
of Their Musts and Wines*

M. A. AMERINE • A. J. WINKLER



CALIFORNIA AGRICULTURAL  
EXPERIMENT STATION

**BULLETIN 794**



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## CONTENTS

GRAPE-GROWING REGIONS . . . . .	5
WHAT MAKES A GOOD WINE GRAPE VARIETY? . . .	6
RECOMMENDED OR ACCEPTABLE VARIETIES . . . .	10
<i>Aleatico</i> . . . . .	10
<i>Aligoté</i> . . . . .	11
<i>Barbera</i> . . . . .	12
<i>Cabernet Sauvignon</i> . . . . .	13
<i>Carignane</i> . . . . .	14
<i>Chardonnay</i> . . . . .	14
<i>Chenin blanc</i> . . . . .	15
<i>Clairette blanche</i> . . . . .	16
<i>Emerald Riesling</i> . . . . .	17
<i>Flora</i> . See <i>Gewürztraminer</i> .	
<i>Fernão Pires</i> . . . . .	18
<i>French Colombard</i> . . . . .	19
<i>Gamay Beaujolais</i> . . . . .	20
<i>Gewürztraminer</i> . . . . .	21
<i>Grenache</i> . . . . .	21
<i>Grillo</i> . . . . .	22
<i>Malvasia Bianca</i> . . . . .	23
<i>Marzemino</i> . . . . .	24
<i>Melon</i> . . . . .	24
<i>Merlot</i> . . . . .	25
<i>Mission</i> . . . . .	25
<i>Muscat Canelli</i> . . . . .	26
<i>Muscat of Alexandria</i> . . . . .	28
<i>Muscat Frontignan</i> . See <i>Muscat Canelli</i> .	
<i>Orange Muscat</i> . . . . .	28
<i>Petite Sirah</i> (California) . . . . .	29
<i>Petite Sirah</i> (French) . . . . .	30
<i>Pinot blanc</i> . . . . .	31
<i>Pineau blanc de la Loire</i> . See <i>Chenin blanc</i> .	
<i>Pinot noir</i> . . . . .	32
<i>Raboso Piave</i> . . . . .	33
<i>Red Veltliner and Red-White Veltliner</i> . . . . .	34
<i>Refosco</i> . . . . .	35
<i>Ruby Cabernet</i> . . . . .	36
<i>Salvador</i> . . . . .	37
<i>Sauvignon blanc</i> . . . . .	37
<i>Sémillon</i> . . . . .	38
<i>Souzão</i> . . . . .	40
<i>Sylvaner</i> . . . . .	40
<i>Teroldico</i> . . . . .	42
<i>Thompson Seedless</i> . . . . .	42
<i>Tinta Cão</i> . . . . .	43
<i>Tinta Madeira</i> . . . . .	44
<i>Touriga</i> . . . . .	44
<i>Verdelho</i> . . . . .	45
<i>White Pinot</i> . See <i>Chenin blanc</i> .	
<i>White Riesling</i> . . . . .	46
<i>Xeres</i> . . . . .	47
<i>Zinfandel</i> . . . . .	47

## NONRECOMMENDED VARIETIES . . . . . 48

<i>Cabernet franc</i> . . . . .	48	<i>Peverella</i> . . . . .	65
<i>Ezerjo</i> . . . . .	49	<i>Pfeffer</i> . . . . .	66
<i>Gamay de Burgoyne</i> . . . . .	49	<i>Pinot gris</i> . . . . .	67
<i>Gamay Teinturier</i> . . . . .	50	<i>Pinot Pernand</i> . . . . .	68
<i>Green Veltliner</i> . . . . .	50	<i>Pinot St. George</i> . . . . .	68
<i>Golden Chasselas</i> . See <i>Palomino</i> .		<i>Preto Manteudo</i> . . . . .	69
<i>Grignolino</i> . . . . .	51	<i>Prosecco</i> . . . . .	70
<i>Limburger</i> . . . . .	51	<i>Red Traminer</i> . . . . .	70
<i>Malbec</i> . . . . .	52	<i>Saint Émilion</i> . . . . .	71
<i>Marsanne</i> . . . . .	53	<i>Saint Macaire</i> . . . . .	72
<i>Mataro</i> . . . . .	53	<i>Sangiovetto</i> . . . . .	72
<i>Mathiasz y-ne</i> . . . . .	54	<i>Sauvignon vert</i> . . . . .	73
<i>Meunier</i> . . . . .	54	<i>Steinschiller</i> . . . . .	74
<i>Mortagua</i> . . . . .	55	<i>Talia</i> . . . . .	74
<i>Müller-Thurgau</i> . . . . .	55	<i>Tamarez</i> . . . . .	75
<i>Muscat Hamburg</i> . . . . .	56	<i>Tannat</i> . . . . .	75
<i>Muscat Saint Laurent</i> . . . . .	57	<i>Teinturier</i> . . . . .	76
<i>Muscat Terracina</i> . . . . .	57	<i>Tinta Miuda</i> . . . . .	76
<i>Nebbiola</i> <sup>41</sup> . . . . .	58	<i>Tinta Mole</i> . . . . .	76
<i>Negrara Gattinara</i> . . . . .	59	<i>Tinta Pinheira</i> . . . . .	76
<i>Neiretta</i> . . . . .	60	<i>Trebbiano</i> . See <i>St. Émilion</i> .	
<i>Nicholas Horthy</i> . . . . .	60	<i>Trincadeira</i> . . . . .	77
<i>Orleans (Riesling)</i> . . . . .	60	<i>Trousseau</i> . . . . .	78
<i>Pagadebitto</i> . . . . .	61	<i>Ugni blanc</i> . See <i>St. Émilion</i> .	
<i>Palomino</i> . . . . .	61	<i>Valdepeñas</i> . . . . .	78
<i>Parreira</i> . . . . .	63	<i>Verdea</i> . . . . .	79
<i>Pe Agudo</i> . . . . .	63	<i>Wälschriesling</i> . . . . .	80
<i>Perruno</i> . . . . .	64	<i>White Elbling</i> . . . . .	80
<i>Petite Bouschet</i> . . . . .	64	<i>White Veltliner</i> . . . . .	81
<i>Petite Verdot</i> . . . . .	65		

## LITERATURE CITED . . . . . 82

## ACKNOWLEDGMENTS . . . . . 83





*The usefulness of a given variety of grape for winemaking depends on:*

Scion-stock interrelationships

Susceptibility to disease

Inherent vigor of the vine

Yield and composition of the grapes under various soil and climatic conditions

*Other points to be considered in evaluating a variety are:*

1. The influence of environmental conditions—rainfall, wind, fog, humidity, exposure, mean daily temperature, time of maturity.

2. Adaptability of the must to various vinification and amelioration practices—temperature, type of yeast, aeration, and others.

3. Suitability of the wine for aging in the wood and in the bottle—rate of clarification, bouquet development, and disease resistance.

4. The basic quality of the wine produced by the variety.

Wine production involves the complex interrelation, interaction, and mutual influence of these factors on each other.

This bulletin reports results of studies made from 1946 to 1958 on about 100 grape varieties. Detailed tables show analyses of musts and wines from those varieties.

# CALIFORNIA WINE GRAPES:

## *Composition and Quality of Their Musts and Wines*<sup>1</sup>

STUDIES SIMILAR to those summarized here, that were made between 1935 and 1942, have been reported elsewhere (Amerine and Winkler, 1944).<sup>2</sup> Analytical data from tables in the earlier work are included in tables presented here, but the main emphasis is on the post-World War II studies.

### GRAPE-GROWING REGIONS

THE REGIONAL CLASSIFICATION is based on the amount of heat received during the growing season. The regions are defined as follows:

*Region I*, the coolest in which grapes are grown. Alameda County, Mission San Jose; Napa County, Napa and Oakville; San Benito County, San Juan Bautista; San Mateo County, Woodside; Santa Clara County, Saratoga; Santa Cruz County, Bonny Doon and Vinehill districts; Sonoma County, Guerneville, Santa Rosa, and Sonoma.

*Region II*, the most important table wine district. Monterey County, Soledad; Napa County, Rutherford, St. Helena, and Spring Mountain; San Benito County, Hollister; Santa Barbara County, Santa Barbara; Santa Clara County, Almaden district, Evergreen, Guadalupe district, and Los Gatos; Sonoma County, Glen Ellen.

*Region III*, moderately warm. Alameda County, Livermore and Pleasanton; Mendocino County, Calpella, Ukiah, and Hopland; Monterey County, King City; Napa County, Calistoga; San Diego County, Alpine; San Luis Obispo County, Templeton; Santa Cruz County, Loma Prieta; Sonoma County, Alexander Valley, Asti, and Cloverdale.

*Region IV*, warm. Merced County, Livingston; San Bernardino County, Guasti; San Diego County, Escondido; San Joaquin County, Acampo, Esca-

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<sup>2</sup> See "Literature Cited" for citations referred to in the text by author and date.

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#### THE AUTHORS:

M. A. AMERINE is *Professor of Enology and Enologist* in the Experiment Station, Davis.

A. J. WINKLER is *Professor of Viticulture and Viticulturist* in the Experiment Station, Emeritus, Davis.

lon, Lockeford, Lodi, and Manteca; Solano County, Cordelia; Stanislaus County, Ceres, Hughson, and Vernalis; Ventura County, Ojai; Yolo County, Davis.

*Region V*, the warmest grape-growing area. Fresno County, Fresno and Sanger; Kern County, Bakersfield and Delano; Madera County, Madera; Merced County, Merced; Tulare County, Trocha.

# WHAT MAKES A GOOD WINE GRAPE VARIETY?

IN THE FINAL EVALUATION, the first consideration must be how the grape will be used. No variety that produces wines lacking in character can be recommended for the production of quality wines. For bulk wines, the basic essentials of composition and character must be considered, and sufficient emphasis must be placed on the production factors. The final selection thus depends on yield, ease of vineyard management, and quality of the product.

*Climate.* The importance of climate has been emphasized previously (Amerine and Winkler, 1944). The regions of study indicated on page 5 were based on summation of temperature, defined as degree-days above 50° F for the period April to October, inclusive. The average degree-days for the regions are as follows: Region I, less than 2,500; Region II, 2,501 to 3,000; Region III, 3,001 to 3,500; Region IV, 3,501 to 4,000; Region V, 4,001 or more. Temperature summations for Regions I to V, 1946 to 1958, inclusive, are

TABLE 1. TEMPERATURE SUMMATION (DEGREE-DAYS)\* FOR TYPICAL LOCATIONS IN REGIONS I TO V, 1946 TO 1958

Year	Location				
	Ben Lomond	Santa Rosa	Livermore	Pomona	Fresno
1946.....	2,288	2,420	2,814	3,734	4,804
1947.....	2,522	3,014	3,292	3,793	4,683
1948.....	2,293	2,321	3,541	3,630	4,552
1949.....	2,330	2,626	3,342	3,872	4,852
1950.....	2,308	2,732	3,716	3,845	4,711
1951.....	2,057	2,534	3,358	3,615	4,552
1952.....	2,338	2,712	3,562	3,766	4,725
1953.....	1,949	2,524	2,974	3,421	4,170
1954.....	2,369	2,745	3,159	3,724	4,573
1955.....	2,150	2,538	3,024	3,632	4,549
1956.....	2,190	2,651	3,151	3,794	4,356
1957.....	2,386	2,895	3,429	3,873	4,314
1958.....	2,754	3,153	3,943	4,218	4,846
Average.....	2,303	2,681	3,331	3,763	4,591

\* Degree-days are calculated as follows:  
If the mean temperature over a five-day period was 70° F, the summation would be (70 - 50 = 20) × 5 = 100 degree-days. A degree-day is one on which the temperature was above 50° F, during the period from April to October, inclusive.



given in table 1. Note that the summation for one season for a given region may overlap that of another region in another season. However, the relative position of the regions remains fairly uniform.

Degree days are calculated as follows: If the mean temperature over a five-day period, for example, was  $70^{\circ}$  F, the summation would be  $(70 - 50 = 20) \times 5 = 100$  degree days.

*Production.* The necessity of adequate production is self-evident. However, varieties which produce only moderate yields continue to be widely planted throughout the world because they produce outstanding wines—notably the Cabernet Sauvignon and Chardonnay. The amount of crop produced also has a marked influence on the composition of the grapes. In years of light crop or, in general, with vines that have a small number of clusters, ripening is more nearly normal, and at maturity the balance of all constituents is better. This, of course, influences the character and type of wine.

High-producing varieties should not be planted in districts where only low production is possible, nor should low-producing varieties be planted in districts that primarily favor high yields. Heavy producers, however, are essential in making common, standard-quality wine.

A quality grape variety results from a complex of several production factors. The condition of the grapes at harvest is very important. Varieties which easily become moldy, sunburned, or rotten, or which are attacked by insects, are more difficult to pick and to deliver to the winery in a satisfactory condition. This is particularly important now that grapes are being inspected for defects at the time of delivery. Such grapes either contribute undesirable spoilage organisms to the musts or give off-tastes to the wine. These varieties, whether white or black, cannot be used for producing high-quality white wines. Diseased fruit is sometimes high in oxidizing enzymes that discolor the white musts and wines. Yield and the soundness of the fruit must both be considered from the production point of view.

*Composition.* The chemical composition of the musts is also important. The sugar-acid relation may apparently take any one of four forms although for a given variety this is influenced somewhat by amount of crop and various environmental conditions. The four forms are: low sugar with low acid; low sugar with high acid; medium sugar with medium to high acid; and high sugar with low acid. The status of this relation will largely determine whether or not the grape is to be used for table wine or for dessert- or appetizer-wine production. The dry table wines, for example, require grapes of fairly low pH (3.0 to 3.35), high acidity (0.65 to 0.9 per cent), and moderate sugar content ( $19^{\circ}$  to  $23^{\circ}$  Balling). For sweet table wines and the dessert and appetizer wines, on the other hand, the musts should be of a higher pH (3.3 to 3.65), medium acidity (0.5 to 0.6 per cent), and more generous sugar content (at least  $24^{\circ}$  Balling).

The Balling-acid ratio has also been shown to be useful in classifying the varieties of wine grapes within a given region (Amerine and Winkler, 1940). In Region IV, varieties with ratios below 28.6, 31.4, and 34.3 at  $20^{\circ}$ ,  $22^{\circ}$ , and  $24^{\circ}$  Balling, respectively, are typical dry table-wine grapes. Varieties with

ratios exceeding these figures at the Balling degrees given are typical dessert-wine grapes. Some varieties have a ratio below 28.6 at 20° Balling, but exceed 31.4 and 34.3 at 22° and 24° Balling. These should be grown in a cooler location for table wines and a warmer location for dessert wines. About 100 varieties have been tested by this system for Davis conditions by means of periodic sampling throughout the ripening period.

Tables for the Balling-acid ratio for different varieties have recently been published (Berg, 1960). These provide useful information for delivery of grapes, and suggest grades according to the ratio. A number of wineries now utilize such tables in grading and paying for grapes.

The importance of a low pH in fermentations of must intended for table wines is well known (see, for example, Amerine and Joslyn, 1951). The utility of detailed studies of the acids in ripening grapes for differentiating wine-grape varieties was demonstrated by Amerine and Winkler (1942).

Other composition factors are also important. The presence or absence of anthocyanin pigments will determine whether a red wine may be produced. Numerous varieties that have anthocyanin pigments only in the skins may be used, however, for white wines. There appear to be several classes of white wine-grape varieties in so far as the color of wine is concerned. Color may, however, be influenced to a considerable extent by the pH and oxidation-reduction potential of the fermenting must and the resulting wine. The general distinction appears to be between varieties such as Burger, Folle Blanche, and certain Rieslings, with only a small amount of yellow pigment in their skins, and the well-colored varieties, such as Sémillon and Muscat Canelli.

The tannin content of red varieties is also important. The varieties, with typical examples, may be roughly divided as follows: high color with low tannin (Saint Macaire); high color with high tannin (Salvador); low color with low tannin (Mission and Grenache); and low color with high tannin (Grignolino and Troia de Barletta). The other composition factors, such as inherent flavor and the flavor produced in wine making, have been discussed by Amerine, Roessler, and Filipello (1959).

*Time of Maturation.* In cool regions, early-ripening varieties are necessary if the fruit is to ripen properly. With the possible exception of the coolest portion of Region I, early-ripening varieties are not essential in California, and, in most regions of the state, are at a disadvantage for two reasons. First, they ripen during the hottest period of the year, and their Balling-acid ratio is unduly increased. Second, unless the grower is particularly careful, the grapes will become overripe very rapidly, before the winery is ready to receive them. The only possible advantages of such varieties are to prolong the picking season in very large vineyards and to provide high sugar concentration in cool, unfavorable years. The latter is a minor consideration in this state. Varieties such as Chasselas doré, Meunier, and Gewürztraminer are seldom useful in warm regions because of their very early ripening.

Late-ripening varieties, on the other hand, are at a distinct disadvantage in Regions I and II, where they fail to mature in cool seasons. In Regions III, IV,

and V they deserve more attention. Their late ripening enables them to escape the severe heat of September. The climate is hot enough, however, so that they mature normally. Since most of the very large vineyards are located in Regions IV and V, the planting of such varieties will help to prolong the picking season without permitting the grapes to become overmature.

*Blends.* The varieties recommended for planting under the various climatic conditions of the state are given in the sections which follow. In some early listings in California, mixed plantings were recommended. In the present report the recommendations are to keep varieties segregated to facilitate harvesting and utilization. A given vineyardist in Region I may wish to plant one or all of the recommended varieties. In each of the regions, varieties are recommended for making quality red or white wines or for making standard red or white wines. The individual grower must determine which type of wine he wishes to produce, or how much of each, and make his selections accordingly. In large plantings due consideration should be given to varieties having a sequence of ripening, in order to spread the harvest labor demand over a longer period.

Some growers will wish to plant a number of varieties for production of several types of wine or for blending. Blending may be considered from the standpoint either of the varieties of grapes or the types of wines. Many useful varieties of grapes are deficient in one or more necessary substances, and even varieties which are ordinarily sufficiently well balanced for producing a satisfactory wine will, under some environmental conditions, fail to attain their normal composition. Deficiencies in color, sugar, or acid content are common examples of this. In addition, certain types of wine require a particularly nice "balance" which is not often achieved from any single variety of grape. Securing the exact balance in a sparkling wine stock is an example of this. In either case, blending is a desirable and useful procedure. But blending is not a cure-all, and its indiscriminate use will lower the average quality of the products of the winery. Varieties which possess no particular merit and which are either markedly deficient in or overabundant in color or acid had better be discarded, no matter what their production, rather than try to rectify them with special grapes and special vinification procedures. This is especially true for the ordinary varieties of grapes when acceptable substitutes exist. Likewise, it would frequently be better to leave varietal wine types undiluted, and age them longer, rather than dilute them beyond recognition in order to achieve an early maturity.

*Freedom from Viruses.* Whatever variety is selected, the grower must take great care to make sure that the planting stock is free of virus diseases. Some viruses reduce production markedly while others alter the balance of the constituents of the fruit so that it fails to attain normal maturity. A number of nurseries now have virus-free grapes, particularly rootstocks. For information on virus-free grapes, contact the University of California Farm Advisor in your area. The Foundation Plant Material Service, University of California, Davis, should be consulted on special problems.



*Present Acreages.* The amount of available grapes of each of the varieties will also be of interest and importance to the grower planting a new vineyard. The present acreages, by varieties, are given in table 2.

TABLE 2. ACREAGE PLANTED TO GRAPES IN CALIFORNIA, 1960

Variety*	Acres	Variety*	Acres
<i>Raisin grapes:</i>			
Muscat of Alexandria.....	22,805	Pinot St. George.....	250†
Thompson Seedless.....	221,269	Refosco (Mondeuse).....	275†
Black Corinth.....	1,933	Ruby Cabernet.....	225†
<i>Table grapes:</i>		Salvador.....	2,194
Almeria.....	1,924	Sangiovese.....	75†
Calmeria.....	576	Tinta Madeira.....	500†
Cardinal.....	3,719	Valdepeñas.....	950
Emperor.....	33,297	Zinfandel.....	25,071
Italia.....	1,936	<i>Wine grapes, white:</i>	
Olivette blanche.....	75†	Aligoté.....	50†
Malaga.....	5,730	Burger.....	2,974
Perlette.....	3,211	Chardonnay.....	150†
Red Malaga.....	3,813	Chenin blanc.....	400†
Ribier.....	7,006	French Colombard.....	1,718
Rish Baba.....	70†	Folle blanche.....	350†
Tokay.....	22,976	Gewürztraminer.....	125†
<i>Wine grapes, black:</i>		Gray Riesling.....	125†
Aleatico.....	160†	Muscat Canelli (Muscat Frontignan)...	225†
Alicante Bouschet.....	10,258	Orange Muscat.....	220†
Barbera.....	220†	Palomino (Golden Chasselas).....	9,145
Cabernet Sauvignon.....	721	Pinot blanc.....	511
Carignane.....	24,967	Saint Émilion.....	120†
Gamay (Napa Gamay).....	785	Sauvignon blanc.....	2,047
Gamay Beaujolais.....	175†	Sauvignon vert (Colombard).....	554
Grenache.....	12,398	Sémillon.....	1,261
Grignolino.....	110†	Sylvaner (Franken Riesling).....	1,300
Mataro.....	3,074	White Riesling (Johannesberger Riesling)...	450†
Mission.....	9,140	All others.....	13,679
Petite Sirah.....	4,703		
Pinot noir.....	300†	Total.....	461,890

Source of data: California Fruit and Nut Acreage 1959, California Crop and Livestock Reporting Service, Sacramento.

\* Local synonyms of certain varieties have been included under the appropriate and correct name in this table.

† Estimates of acreage based on grower contacts.

## RECOMMENDED OR ACCEPTABLE VARIETIES

*Aleatico:* This variety, so important in and typical of the Tuscan region of Italy, has never achieved popularity in California because of its orange-red color, relatively poor vigor and productivity, early ripening, and tendency to sunburn. Its great merit is, of course, the fragrant and subtle muscat aroma of its fruit and wines (when the fruit is not raisined or sunburned). Breviglieri and Casini (1960) have summarized Italian experience with the Aleatico, noting particularly its aromatic odor. Most of the wines were sweet.

Analytical data of the pre- and post-World War II studies are summarized in table 3. Production at Davis has varied from 5 to 9 tons per acre, with an average of 6.2. Dry white, rosé, sweet table, and white and pink dessert wines have been produced, the best being the white dessert types. The pH is high.

TABLE 3. COMPOSITION OF MUSTS\* AND WINES OF ALEATICO

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Balling	Total acid	pH	Alcohol	Fixed acid	Extract	Tannin	Color intensity†	Average score‡
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
IV:												
1935-42.....	6	9	Sept. 28	25.34	0.557	3.55	18.83	0.402	12.26	0.058	101	....
1946-58.....	5	7	Oct. 2	23.59	0.699	3.47	19.62	0.473	11.96	0.043	22.6	75.3
V:												
1935-42.....	2	3	Aug. 26	22.80	0.570	3.77	18.40	0.370	11.80	0.080	101	....

\* Prewar as red must, postwar as white must.

† Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

‡ On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

Aleatico variety is recommended for planting in California only where it meets special winery requirements.

*Aligoté*: This variety has now been extensively tested in Regions I and II (13 samples) and in IV (16 samples). The pre- and post-World War II analyses of dry table wines from *Aligoté* grapes are summarized in table 4. Production at Davis has averaged about 6 tons per acre, with a maximum of 9.7. During a five-year period at Oakville, production averaged 4.4 tons per acre.

In the cooler regions, the Balling readings and pH are expectedly lower, the total acidity is higher, and the quality is generally better. However, only four or six of the wines can be considered of exceptional quality, and only one of these is from Region IV.

*Aligoté* is especially appreciated in Russia and Roumania. From the latter, Constantinescu and Negreanu (1957) and Constantinescu (1959) give many

TABLE 4. COMPOSITION OF MUSTS AND WINES OF ALIGOTÉ

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Balling	Total acid	pH	Alcohol	Fixed acid	Extract	Tannin	Color intensity*	Average score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
I:												
1935-42.....	2	2	Oct. 3	23.75	0.52	2.20	13.05	0.53	2.25	0.025	....	....
1946-58.....	7	9	Oct. 1	22.68	0.718	3.28	13.28	0.702	2.57	0.037	8.0	74.9
II:												
1946-58.....	2	2	Sept. 30	20.90	0.685	3.15	12.10	0.692	2.40	0.25	9.0	75.8
IV:												
1935-42.....	2	2	Sept. 8	22.10	0.60	3.46	12.2	0.52	2.5	0.05	14.0	....
1946-58.....	12	14	Sept. 25	23.37	0.711	3.47	12.77	0.629	2.46	0.028	10.5	74.8

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.



analyses, with special praise for the grape's regular production and good sugar. These investigators found that the acidity varied with the region and season, but tended to be only modest.

For California, Aligote can be given only a qualified recommendation for planting in Regions I and II.

*Barbera*: This is not a vigorous grower, although some commercial tests and those at Davis indicate that it can produce normal crops. At Davis, average crops of 8.2 tons per acre were obtained over a 14-year period. In five years at Oakville, production averaged 4.3 tons per acre.

The variety was tested extensively in all regions (table 5) because its high total acidity indicated that it should produce superior wines under California conditions. Bioletti (1908) recommended it for Regions IV and V for its color and acidity. A number of good and a few superior wines have been produced. Tests were made of both red and rosé wines (12 from the cool regions and 26 from the warmer regions).

When no malo-lactic fermentation occurs, the wines from this grape are too acid. The wines that have undergone a malo-lactic fermentation have varied widely in quality, depending on how extensive the rise in pH (and drop in acidity) has been. In our small-scale lots, this variability has proved difficult to control. With present methods, we believe that practicable industrial control and maximum quality can be regularly achieved. Certainly the variety is best adapted to our warmer regions. It is recommended for Region IV, especially for use in blending to increase the acidity of other musts.

TABLE 5. COMPOSITION OF MUSTS AND WINES OF BARBERA

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color inten-sity*	Aver-age score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
I:												
1935-42.....	..	..	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1946-58.....	3	3	Oct. 2	23.1	1.01	3.13	13.1	0.92	3.3	0.09	132	76.2
II:												
1935-42.....	4	4	Oct. 8	23.5	0.74	3.31	13.2	0.65	2.8	0.18	476	.....
1946-58.....	4	5	Oct. 1	22.4	1.18	3.15	11.9	0.86	3.1	0.13	368	76.2
III:												
1935-42.....	5	8	Sept. 21	23.5	0.98	3.17	11.8	0.86	3.1	0.14	424	.....
1946-58.....	2	2	Sept. 25	24.5	1.18	3.10	12.0	0.74	3.4	0.16	392	77.0
IV:												
1935-42.....	7	16	Sept. 16	23.3	0.98	3.23	12.0	0.68	2.9	0.11	173	.....
1946-58.....	12	23	Sept. 26	22.8	1.15	3.22	11.9	0.81	3.2	0.11	203	74.8
V:												
1935-42.....	3	4	Aug. 20	22.1	0.82	3.24	10.8	0.62	2.9	0.09	136	.....
1946-58.....	6	6	Sept. 7	22.8	1.07	3.28	11.1	0.94	3.1	0.08	143	74.5

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

For a history and description of Barbera, see Dalmasso *et al.* (1959). They show a photograph of one type of Barbera with a stem length of 8 cm and a cluster of only 15 cm. Because of the high must acidity noted, these workers recommended that the must be prepared with 1 to 3 per cent residual sugar.

*Cabernet Sauvignon*: Wines of this variety have been among the best produced in our tests and in those of our predecessors. Its distinctive aroma is probably the main basis of the wine's high quality. That the variety has defects no one denies—vines of relatively low yield, and wine somewhat high in tannin, and slow aging.

For information on the history, description, and composition of Cabernet Sauvignon see Winkler and Olmo (1937*a*) and Cosmo, Forti, and Sardi (1959). The latter reported widely variable total acidity in northern Italy (0.43 to 0.79, average 0.65, for 23 wine samples). The tannin content was also variable and on the high side (0.09 to 0.36, average 0.19). Reports show that Cabernet Sauvignon grapes sold in South Australia at prices of 32 to 55 per cent greater than that for Cabernet franc (Anonymous, 1960, 1961). Constantinescu (1959) calls attention to the world-wide distribution of Cabernet Sauvignon. Surprisingly, he found that it produced excellent crops in Roumania. For further information on its vinification in California see Amerine (1949).

Winkler (1959) has shown that average yields of 4.2 and 4.7 tons per acre were obtained with 6 × 12- and 8 × 12-foot spacing, respectively, at Oakville. At Davis the yield has averaged 7 tons. The analyses are given in table 6. The excessive tannin (and hence slow aging) is not an unmixed blessing for

TABLE 6. COMPOSITION OF MUSTS AND WINES OF CABERNET SAUVIGNON

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine						
				Balling	Total acid	pH	Alcohol	Fixed acid	Extract	Tan- nin	Color inten- sity*	Average score†	
				<i>degrees</i>	<i>gm/ 100cc</i>		<i>per cent vol.</i>	<i>gm/ 100cc</i>	<i>gm/ 100gm</i>	<i>gm/ 100cc</i>			
I:													
1935-42.....	7	23	Oct. 7	22.6	0.72	3.28	11.9	0.64	2.6	0.15	307	....	
1946-58.....	11	32	Oct. 10	22.0	0.81	3.33	11.8	0.76	3.1	0.16	394	77.7	
II:													
1935-42.....	7	23	Oct. 4	24.3	0.61	3.34	13.0	0.62	3.0	0.15	411	....	
1946-58.....	6	16	Oct. 2	21.5	0.81	3.26	11.4	0.66	3.0	0.12	423	76.3	
III:													
1935-42.....	6	10	Sept. 22	23.3	0.59	3.45	12.1	0.57	2.8	0.18	349	....	
1946-58.....	4	4	Sept. 15	20.4	0.83	3.30	9.8	0.76	2.9	0.16	213	77.3	
IV:													
1935-42.....	7	24	Sept. 28	23.2	0.65	3.55	11.3	0.45	3.1	0.11	203	....	
1946-58.....	13	30	Sept. 26	22.9	0.75	3.46	11.4	0.57	3.1	0.13	229	74.7	
V:													
1935-42.....	5	5	Aug. 26	23.3	0.54	3.45	12.0	0.52	3.1	0.15	240	....	
1946-58.....	5	5	Aug. 22	21.2	0.76	3.34	10.6	0.52	2.8	0.10	127	75.3	

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

the highest quality wine. However, Cabernet Sauvignon is the variety of choice for red table wines in Regions I and II.

*Carignane*: This variety has been thoroughly tested in California. Davis production has been 8 to 10 tons per acre. Its vigor and productivity recommend Carignane to the grower. However, it produces only standard quality wines in Regions II, III, or IV. It is not recommended for Region I, because of its susceptibility to mildew, nor for Region V, where bunch rot is often prevalent in Carignane vineyards. Even in Regions II and III, it should not be planted in areas of high humidity.

In some years, and especially when the vines have been overcropped, the acidity is very low, and stuck fermentations have resulted.

The analytical data are given in table 7.

TABLE 7. COMPOSITION OF MUSTS AND WINES OF CARIGNANE

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Balling	Total acid	pH	Alcohol	Fixed acid	Extract	Tannin	Color intensity*	Average score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
I:												
1935-41.....	6	12	Oct. 10	21.3	0.73	3.45	11.2	0.57	2.5	0.13	281	....
1946-58.....	1	1	Oct. 5	23.4	0.69	3.30	12.3	0.58	2.7	0.19	357	73.5
II:												
1935-41.....	5	18	Sept. 26	21.3	0.69	3.44	11.4	0.53	2.5	0.11	203	....
1946-58.....	4	5	Oct. 13	20.8	0.92	3.30	10.0	0.77	2.8	0.10	211	73.9
III:												
1935-41.....	7	23	Sept. 25	22.7	0.67	3.43	12.0	0.60	3.1	0.12	304	....
1946-58.....	3	5	Sept. 29	22.7	0.76	3.32	12.1	0.76	2.9	0.14	272	73.1
IV:												
1935-41.....	5	13	Sept. 29	22.9	0.59	3.82	11.9	0.51	2.8	0.10	184	....
1946-58.....	5	13	Sept. 28	22.4	0.73	3.49	12.1	0.62	3.0	0.09	192	73.0
V:												
1935-41.....	3	10	Sept. 3	22.2	0.58	3.73	11.6	0.46	....	0.12	171	....
1946-58.....	2	4	Aug. 15	20.3	0.86	3.40	11.6	0.71	2.7	0.09	169	73.5

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

*Chardonnay*: The fine wines produced by this variety in the Côte d'Or region of France have recommended it to producers throughout the world. It is found in Italy, Hungary, Roumania, and other European countries. Many excellent wines have been produced from it in California. However, it is a shy bearer, it ripens early under the warm climatic conditions of California, and its wines are often difficult to stabilize.

At Davis, Chardonnay has an average production of 5.5 tons per acre, although it has produced as much as 7.1 tons. At Oakville, during a four-year period, it has averaged 4.4 tons per acre.



The present results substantiate those published earlier (Amerine and Winkler, 1944): the quality of the wines is uniformly high in the cool regions and often is exceptional even in the warmer regions. The distinctive "ripe grape" aroma is not always present, and we are at a loss to explain why. For example, for the Oakville vineyard, Region I, the average Balling of six musts was 24.5°, from which 13.7 per cent alcohol was produced. This is certainly adequate maturity. Yet a detailed study of the 12 tasting records shows that none was marked as especially distinctive. We have also noted that a number of commercial Chardonnay wines were not especially distinctive as to aroma, possibly due, in some cases, to too early harvesting or blending. But this cannot explain why more of our Chardonnay wines are not of characteristic aroma. The analytical results are given in table 8.

We believe that Chardonnay plantings of good-yielding clones may be made very cautiously in Regions I and II.

TABLE 8. COMPOSITION OF MUSTS AND WINES OF CHARDONNAY

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Balling	Total acid	pH	Alcohol	Fixed acid	Extract	Tannin	Color intensity*	Average score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
I:												
1935-41.....	2	3	Sept. 25	21.3	0.74	3.32	11.5	0.57	2.3	0.04	10.0	....
1946-58.....	6	6	Sept. 20	24.3	0.79	3.22	13.7	0.71	2.6	0.03	9.6	77.0
II:												
1946-58.....	2	3	Sept. 15	22.5	0.88	3.33	13.0	0.75	2.7	0.03	10.3	77.8
III:												
1935-41.....	5	6	Sept. 9	25.1	0.61	3.43	13.9	0.57	3.0	0.05	15.5	....
1946-58.....	3	3	Sept. 22	23.3	0.73	3.47	12.7	0.72	2.5	0.02	15.7	77.8
IV:												
1935-41.....	5	9	Aug. 29	23.0	0.82	3.56	12.2	0.54	2.8	0.04	18.9	....
1946-58.....	13	32	Sept. 13	23.0	0.84	3.54	12.6	0.71	2.9	0.03	14.8	75.9

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

*Chenin blanc*: This variety is more often called White Pinot in California, reflecting one of its synonyms—Pineau blanc de la Loire. It is not, however, a member of the Pinot family of grape varieties. Its very special merits are: good and regular production; relative ease of harvesting and crushing; and a fresh and fruity character in its wine. Its disadvantages are a susceptibility to bunch rot in wet years, and a tendency to overcrop.

At both Oakville and Davis it is a good producer. Over a 14-year period it averaged nearly 10 tons per acre at Davis, and during a four-year period, 5.8 tons at Oakville. Its musts are of very good balance in the cooler region and are of above average quality in the warmer area (table 9). Yet few of its wines have scored higher than good.

TABLE 9. COMPOSITION OF MUSTS AND WINES OF CHENIN BLANC

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color inten-sity*	Aver-age score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
I:												
1935-41.....	1	1	Oct. 1	25.5	0.44	3.38	14.2	0.46	2.4	0.04	....	....
1946-58.....	6	7	Oct. 5	23.6	0.61	3.43	13.8	0.65	2.7	0.02	7.1	76.1
II:												
1946-58.....	2	2	Sept. 20	20.5	0.80	3.35	11.6	0.72	2.5	0.03	9.5	74.5
III:												
1946-58.....	2	2	Sept. 20	23.1	0.91	3.25	13.0	0.86	2.7	0.03	10.5	75.0
IV:												
1935-41.....	6	6	Sept. 24	23.0	0.66	3.56	11.9	0.46	3.1	0.03	9.0	....
1946-58.....	11	14	Sept. 24	21.0	0.88	3.34	11.6	0.75	2.8	0.03	9.1	74.8

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

It can be recommended for standard wines in the cooler regions, where it is better than Veltliner, Burger, Green Hungarian, and French Colombard. It should probably not be planted in the warmer regions.

*Clairette blanche*: This variety has been tested for many years in California but has achieved little recognition. At Oakville it is a moderately good producer—7.3 tons per acre during a three-year period. Surprisingly, Constantinescu (1959) reported it a poor producer in Roumania. However, its alcohol yield was very variable, possibly indicating rather heavy crops in certain years.

TABLE 10. COMPOSITION OF MUSTS AND WINES OF CLAIRETTE BLANCHE

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color inten-sity*	Aver-age score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
I:												
1937-40.....	2	2	Oct. 8	21.3	0.67	3.22	12.2	0.56	1.8	0.04	6	....
1953-58.....	5	5	Sept. 28	23.4	0.73	3.36	13.6	0.72	2.6	0.02	8	76.7
II:												
1936-39.....	3	3	Oct. 7	22.5	0.57	3.17	12.9	0.53	2.1	0.03	27	....
1951.....	1	1	Sept. 15	24.0	0.90	3.50	13.0	0.68	2.8	0.02	13	75.0
IV:												
1935-41.....	7	10	Sept. 15	21.4	0.56	3.38	11.6	0.43	2.1	0.05	15	....
1948-57.....	10	10	Sept. 16	21.8	0.79	3.44	12.2	0.68	2.6	0.02	21	74.1
V:												
1940.....	1	1	Aug. 16	18.3	0.39	3.46	10.5	0.39	2.0	0.03	9	....
1950.....	1	1	Sept. 5	21.5	0.50	4.30	....	....	....	....	....	....

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.



Although no exceptional wines have been produced from Clairette blanche, its wine is moderately distinctive. It may thus be considered an above-average quality wine of no general interest for California conditions. The analytical data, given in table 10, show that the wine retains a fair acidity in Region IV.

*Emerald Riesling*: A considerable amount of information has accumulated since the variety was introduced by Olmo (1948). Berg and Akiyoshi (1956), for example, found its wines to brown quicker than those of any other commonly planted white wine grape variety except the Pinot blanc (p. 31).

Its merits are high yield and high acidity. Over a seven-year period at Davis the yield averaged 12.1 tons per acre. At Oakville during a five-year period it averaged 6.5 tons per acre. This variety should not be planted in the cooler regions, where its acidity is often excessively high. In one case, it is being grown most successfully in a cool region, but in a mixed planting with Palomino, a variety of notoriously low acidity. For the warmer regions, it appears to be well suited for standard wines, although occasionally subject to bunch rot in those areas. It equals French Colombard in bearing, and is easier to harvest. Both have musts of relatively high total acidity.

This variety's tendency to brown may be alleviated by handling with care; harvesting at the proper time; crushing rapidly; separating the free-run juice immediately; and settling of the musts to remove solids. Due precautions to prevent oxidation during operations should, of course, be taken. One other problem is that of relatively murky musts, which reflect the muscat parent. The measures recommended above may have to be combined with prefermentation chilling and even clarification to overcome this, but should not prove difficult if the winemaker is alert to the problem. Certainly it is worth a qualified recommendation for Regions III to V. The analytical results are given in table 11.

TABLE 11. COMPOSITION OF MUSTS AND WINES OF EMERALD RIESLING

Region and years	No. of years sam- ples taken	No. of sam- ples	Average date of harvest	Must			Wine						
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†	
				degrees	gm/ 100cc		per cent vol.	gm/ 100cc	gm/ 100gm	gm/ 100cc			
I: 1946-58.....	7	8	Oct. 7	22.6	0.96	3.04	13.0	0.95	2.9	0.05	11.0	74.8	
II: 1946-58.....	4	4	Sept. 25	21.1	1.31	3.00	11.3	1.18	3.0	0.04	13.2	72.2	
IV: 1946-58.....	7	10	Oct. 11	22.4	0.99	3.25	12.5	0.88	2.9	0.03	15.9	74.5	

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

*Fernão Pires*: This is the first summary of our studies with this Portuguese variety, imported in 1939 by Olmo. Viticulturally the variety is of moderate vigor and good production, ranging from 9 to 11 tons per acre at Davis.

The variety produces excellent dessert wines of high quality. Its musts are high in sugar but not overly high in pH. The wines are fruity, and give uniformly high scores. If wine quality were the only factor in selection of a variety, then *Fernão Pires* could be recommended. We can give it only a very limited recommendation for Regions IV and V, based on our limited experience with the variety. The analytical data are given in table 12.

*Folle blanche*: This variety has been grown in California for many years. Some of the early plantings were made to provide wine for brandy. It was

TABLE 12. COMPOSITION OF MUSTS AND WINES OF FERNÃO PIRES

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†
				degrees	gm/ 100cc		per cent vol.	gm/ 100cc	gm/ 100gm	gm/ 100cc		
IV:												
1946-58.....	9	11	Sept. 27	24.0	0.70	3.49	18.6	0.45	12.7	0.03	18.8	77.0
V:												
1948-58.....	4	4	Aug. 23	24.8	0.59	3.60	18.5	0.38	13.1	0.05	21.2	76.5

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

TABLE 13. COMPOSITION OF MUSTS AND WINES OF FOLLE BLANCHE

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†
				degrees	gm/ 100cc		per cent vol.	gm/ 100cc	gm/ 100gm	gm/ 100cc		
I:												
1935-41.....	7	14	Oct. 6	20.2	0.87	3.03	11.1	0.70	2.2	0.04	24.0	....
1946-58.....	3	3	Sept. 28	20.5	0.87	3.23	11.9	0.77	2.4	0.02	7.0	76.2
II:												
1935-41.....	7	10	Oct. 3	20.4	0.78	3.03	10.9	0.70	2.2	0.05	18.0	....
1946-58.....	2	3	Sept. 22	19.6	0.90	3.10	10.1	0.92	2.5	0.03	8.3	74.0
III:												
1935-41.....	6	6	Sept. 30	20.0	0.76	3.13	10.6	0.63	2.2	0.04	22.5	....
1946-58.....	4	4	Sept. 22	20.3	0.94	3.22	11.1	0.84	2.6	0.05	15.2	73.5
IV:												
1935-41.....	2	2	Sept. 29	21.5	0.81	3.50	11.2	0.48	2.4	0.04	61.0	....
1946-58.....	4	8	Oct. 18	21.0	0.76	3.46	11.5	0.73	2.3	0.07	20.0	72.2
V:												
1935-41.....	2	2	Aug. 30	18.9	0.69	3.21	9.6	0.47	2.1	0.02	17.0	....
1948-58.....	1	1	Aug. 22	15.9	0.99	3.30	8.2	0.89	2.5	0.02	13.0	71.0

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

early discovered that under the relatively warm conditions of California the variety had sufficient alcohol for table wines, and more particularly was suited to producing sparkling wine stock. Its relatively low alcohol and high natural acidity made it particularly suited to the latter purpose. Nevertheless, the acreage of Folle blanche has steadily declined, due mainly to its susceptibility to bunch rot in cool, humid seasons. As for production—at Davis this variety has averaged 5.6 tons per acre for 13 years; at Oakville the four-year average was 4.7 tons per acre.

Many of the wines of this variety have scored well in these tests, particularly those from Regions I, II, and III. The aroma is often sufficiently distinctive to be recognized. The fresh, fruity flavor is most often praised. However, in view of the increasing surveillance of grapes for mold, it is unlikely that this variety will prove satisfactory. Analytical data are given in table 13. For further data on the variety and its vinification see Amerine (1949).

*French Colombard:* The popularity of this vigorous and productive variety has been increasing in California. Its uniformly good ripening, with above-average production, recommends it to the grower. Production at Davis for a 14-year period averaged 7.1 tons per acre, with a maximum of 14.3. At Oakville, over five years, it averaged 5.9 tons per acre, with a maximum of 8.2. French Colombard produces a standard wine of good acidity, which handles well. These qualities recommend it to the winemaker. As early as 1908 Bioletti had recognized its high acidity, which led him to recommend it for Regions IV and V. It is not without defects. The clusters are often dif-

TABLE 14. COMPOSITION OF MUSTS AND WINES OF FRENCH COLOMBARD

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†
				degrees	gm/ 100cc		per cent vol.	gm/ 100cc	gm/ 100gm	gm/ 100cc		
I:												
1935-41.....	2	2	Sept. 26	20.0	0.85	3.08	11.1	0.67	2.1	0.03	18.0	....
1946-58.....	9	10	Oct. 18	22.6	0.97	3.15	13.0	0.88	2.7	0.03	8.4	76.9
II:												
1935-41.....	2	2	Sept. 30	22.2	0.94	3.05	12.0	0.60	2.5	0.03	10.0	....
1946-58.....	5	9	Sept. 29	20.3	1.16	3.12	11.2	0.94	2.6	0.02	11.9	75.3
III:												
1935-41.....	2	2	Sept. 19	22.6	0.87	3.10	12.3	0.75	2.6	0.04	14.0	....
1946-58.....	5	5	Sept. 17	21.2	1.04	3.10	11.6	0.88	2.6	0.02	11.0	76.2
IV:												
1935-41.....	5	9	Sept. 9	21.2	0.95	3.39	10.9	0.70	2.7	0.03	17.1	....
1946-58.....	9	13	Sept. 27	21.6	1.11	3.35	12.1	0.88	3.0	0.02	12.2	76.0
V:												
1946-58 ....	5	10	Sept. 7	20.9	1.13	3.26	11.3	0.90	2.8	0.03	14.9	75.2

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.



ficult to harvest, and unless harvested at the proper time will produce wines of high alcohol content, with a too distinctive aroma.

French Colombard is one of the most versatile standard varieties now growing in the state. Its natural acidity is too high for Region I unless a blending wine is particularly desired. (However, in warm seasons, and when not overcropped, it has produced some well-balanced wines even in Region I.) In Regions II and III it gives a tart wine which is well-suited for sparkling wine production. In Regions IV and V it makes well-balanced table wines which retain sufficient acidity to make them useful for blending when needed. Analytical results are given in table 14.

*Gamay Beaujolais:* Our observations indicate that the variety grown under this name in the University's vineyards is probably a member of the Pinot family. It resembles Pinot noir in cluster size and shape, leaf character, and wine aroma. According to Rankine *et al.* (1958), the pigment complex also resembles that of Pinot noir. The wines have the same tendency toward a malo-lactic fermentation. It is unlikely that this is the true Gamay, as grown in the Beaujolais region in France (see Truel, 1960). It is also an entirely different grape from the Napa Valley Gamay.

The chief defect of this variety, as shown in the pre- and postwar studies, has been its deficiency in color. Its moderate production is another defect which must be taken into account—average yield at Davis, 4.6 tons per acre. At Oakville, over a three-year period, the yield averaged 5.3 tons per acre. This contrasts markedly with the variety grown under this name in Roumania, which, according to Constantinescu (1959) bears from 8 to 11 tons per acre. Probably it and the Pinot noir should be preferred in Regions I and II, and neither variety should be planted in warmer regions. Analytical data are given in table 15.

TABLE 15. COMPOSITION OF MUSTS AND WINES OF GAMAY BEAUJOLAIS

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color inten-sity*	Aver-age score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
I:												
1935-41.....	3	3	Sept. 29	21.5	0.78	3.23	11.3	0.59	2.6	0.13	208	....
1946-58.....	8	9	Sept. 18	23.1	0.82	3.27	12.5	0.67	3.0	0.11	124	76.9
IV:												
1935-41.....	4	12	Aug. 28	22.8	0.78	3.37	11.5	0.53	3.0	0.10	101	....
1946-48.....	12	18	Sept. 13	22.6	0.86	3.40	11.2	0.57	3.0	0.08	114	73.4
V:												
1935-41.....	1	1	Aug. 15	24.4	0.53	3.70	10.7	0.33	3.1	0.25	55	....

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

*Gewürztraminer*: No data on this variety were collected in the prewar period. The variety is well-known, in Alsace and in Germany, for its spicy, muscat-like aroma. It has one defect—lack of vigor—but the production for a 14-year period has averaged 5.4 tons per acre at Davis. Over the 1956–1958 period at Oakville it averaged 6.1 tons per acre. Our conclusion, which agrees with opinion in Alsace, is that this variety has been unduly condemned for low production. Two clones were found in the University collection, one much less aromatic than the other. It is believed that only the more highly flavored has been retained.

For a recent Italian history and description of *Gewürztraminer* see Cosmo and Polsinelli (1956). These authors note the variety's low vigor and productivity and early maturity. Their analyses also show its wines to be low in acidity and rather high in alcohol, 11.6 to 14.6 per cent (average, 12.7), for 20 northern Italian wines. Nevertheless, they classify it as a superior wine type.

Because of its limited production, this variety should not be planted by growers who do not have a specific outlet, at a good price, in view. Furthermore, the high must pH dictates that the variety should be grown only in the cooler Regions I and II. The new hybrid, *Flora*, is now being extensively tested as a possible substitute for *Gewürztraminer*. It has the advantage of better production and acidity, but the tests to establish the equivalence of aroma are not complete. Analytical results are given in table 16.

TABLE 16. COMPOSITION OF MUSTS AND WINES OF GEWÜRZTRAMINER

Region and years	No. of years sam- ples taken	No. of sam- ples	Average date of harvest	Must			Wine						
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†	
				<i>degrees</i>	<i>gm/ 100cc</i>		<i>per cent vol.</i>	<i>gm/ 100cc</i>	<i>gm/ 100gm</i>	<i>gm/ 100cc</i>			
I: 1946-58.....	7	12	Sept. 20	22.9	0.65	3.46	13.2	0.66	2.8	0.02	9.5	76.0	
IV: 1946-58.....	11	19	Sept. 16	22.6	0.67	3.57	12.7	0.57	2.5	0.02	15.1	75.0	

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

*Grenache*: This variety was recommended by Amerine and Winkler (1944) for table wines of moderate color in the cooler regions and for white dessert wines in the very warmest regions. Because of a demand for rosé wines, grapes of this variety from nearly all regions have been used for this purpose. We do not find this to be justified on the basis of either the pre- or postwar studies. Only grapes from Regions I to III should be used for producing a fruity *Grenache rosé*.

In the cooler regions, *Grenache* produces well-balanced musts, and wines



of above average quality which are, however, often rated down because of a slight astringency. If the juice is taken off the skins early and used as a rosé, the wine does not suffer this defect. Production at Oakville over a five-year period averaged 6.2 tons per acre. At Davis the average was 8.3 tons, with a maximum of 11.1.

In the warmer regions, the musts are too low in acidity and too high in pH for a well-balanced, high quality rosé. Certainly the warm-region wines have little or no distinctive aroma to mark them as different from rosé wines of other commonly-planted varieties.

For dessert wines the present studies confirm the earlier results. In the warm Regions—IV and V—the free-run juice should be used for a white dessert wine—dry or sweet. Analytical data are given in table 17.

TABLE 17. COMPOSITION OF MUSTS AND WINES OF GRENACHE

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color inten-sity*	Ave-age score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
I:												
1935-41.....	4	5‡	Oct. 9	23.9	0.74	3.17	13.5	0.64	2.7	0.12	210	....
1946-58.....	8	11‡	Sept. 30	21.7	0.71	3.05	11.8	0.76	2.9	0.12	126	74.3
II:												
1935-41.....	6	12‡	Oct. 5	24.4	0.57	3.42	13.4	0.55	2.5	0.14	221	....
1946-58.....	6	10‡	Oct. 4	22.8	0.80	3.20	12.3	0.74	2.8	0.10	152	75.7
III:												
1935-41.....	7	14‡	Sept. 21	24.4	0.62	3.20	13.0	0.58	2.5	0.14	241	....
1946-58.....	5	5‡	Sept. 23	24.1	0.67	3.28	13.3	0.66	2.9	0.15	242	74.2
IV:												
1935-41.....	7	21‡	Sept. 30	23.8	0.53	3.51	12.5	0.44	2.5	0.12	243	....
1946-58.....	11	21‡	Sept. 24	23.0	0.67	3.34	12.1	0.59	2.8	0.12	90	74.1
V:												
1935-41.....	2	5‡	Sept. 3	23.1	0.45	3.95	11.5	0.39	2.4	0.10	102	....
1946-58.....	5	11‡	Sept. 21	22.9	0.67	3.40	12.1	0.55	2.8	0.09	65	74.9
IV:												
1946-58.....	4	8§	Oct. 13	23.9	0.70	3.40	20.8	0.41	12.3	0.04	72	76.1
V:												
1935-41.....	4	5§	Sept. 22	25.1	0.43	3.59	19.5	0.28	12.3	0.08	58	....
1946-58.....	4	4§	Sept. 5	23.2	0.63	3.47	18.6	0.52	11.7	0.06	77	73.3

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

‡ Dry red.

§ Sweet.

*Grillo*: This variety has been under intensive study since the war. In Italy there have been reports that it has very special microclimate requirements. In California it has been found to be a variety of considerable promise, with a leafy habit of growth and resistance to sunburn (Amerine, 1955). It is a good producer (up to 10.5 tons per acre), reaches an adequate sugar content, and retains a fair acidity for a dessert-wine grape. Its wines are rich

and flavorful and have been scored very high in blind tastings. Analytical data are summarized in table 18.

TABLE 18. COMPOSITION OF MUSTS AND WINES OF GRILLO

Region and years	No. of years sam- ples taken	No. of sam- ples	Average date of harvest	Must			Wine					
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†
				degrees	gm/ 100cc		per cent vol.	gm/ 100cc	gm/ 100gm	gm/ 100cc		
IV:												
1935-41.....	4	5‡	Sept. 27	26.0	0.61	3.37	14.7	0.46	2.5	0.04	18.0	....
1946-58.....	8	10§	Oct. 6	24.6	0.78	3.45	19.68	0.51	11.8	0.02	9.9	77.4

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50.  
† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.  
‡ As sherry material.  
§ As white sweet wine.

This variety is recommended for planting in the warm regions, IV and V. It should be used primarily for sweet white dessert wines, but can be used for sherry material.

*Malvasia Bianca*: This is a white muscat-flavored variety, not the Italian non-muscat *Malvasia* (Krimbas, 1947). It is a fair producer—4 to 7 tons per acre at Davis—with fair quality of fruit in Regions II and III. Occasionally it is subject to bunch rot in the cooler areas of Region II. The fruit quality in Regions IV and V is almost always excellent. It produces a good quality muscat wine. The pH has not been excessive—a point very much in its favor as a muscat variety. The analytical data are summarized in table 19. At present the *Malvasia Bianca* appears to be a useful addition to our complement of muscat-flavored varieties in Regions IV and V (see Amerine, 1955).

TABLE 19. COMPOSITION OF MUSTS AND WINES OF MALVASIA BIANCA

Region and years	No. of years sam- ples taken	No. of sam- ples	Average date of harvest	Must			Wine					
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†
				degrees	gm/ 100cc		per cent vol.	gm/ 100cc	gm/ 100gm	gm/ 100cc		
II:												
1946-58.....	1	1	Oct. 5	21.1	0.89	3.20	21.9	0.56	11.5	0.02	7.0	74.0
III:												
1935-41.....	1	1	Oct. 16	23.6	0.69	3.47	19.5	0.44	11.8	0.04	12.0	....
IV:												
1935-41.....	3	5	Oct. 5	27.2	0.55	3.69	20.0	0.37	13.3	0.05	25.6	....
1946-58.....	7	7	Oct. 5	25.7	0.67	3.64	18.9	0.44	13.6	0.03	16.4	76.4
V:												
1935-41.....	3	3	Aug. 27	23.9	0.43	3.56	19.3	0.38	10.8	0.04	46.6	....
1946-58.....	2	2	Aug. 28	25.3	0.52	3.45	18.6	0.34	12.4	0.05	27.5	76.8

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.  
† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

*Marzemino*: This variety has been tested only in Region IV, where it has not been of even average quality. It is too low in total acidity and too high in pH for well-balanced red table wine. It is not recommended for further trial in Region IV, but it perhaps should be tried in Region II. Analytical data are given in table 20.

TABLE 20. COMPOSITION OF MUSTS AND WINES OF MARZEMINO

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color inten-sity*	Aver-age score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
IV:												
1935-41.....	5	5	Sept. 29	22.5	0.46	3.75	11.3	0.45	3.0	0.18	410	....
1946-58.....	2	2	Sept. 20	22.0	0.58	3.65	11.1	0.48	3.0	0.12	256	73.7

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.  
† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

*Melon*: This variety has been tested in the postwar period only in Regions I, II, and IV. In the University's vineyard in Region I, the foliar and ripening characteristics are so similar to those of our Pinot blanc that we may be dealing here with the same variety. The musts have been well balanced both in the cooler regions and at Davis, but the best quality wines have come from the cooler regions. The variety has two distinct disadvantages: (1) no virus-free vines appear to be present in commercial vineyards or available for distribution (hence its low production?); (2) like those of Pinot blanc, the wines of Melon variety will darken rather easily. It is possible to handle the must to reduce this darkening, and at least one winery has had good success with the variety. The production data show that it is not a high pro-

TABLE 21. COMPOSITION OF MUSTS AND WINES OF MELON

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color inten-sity*	Aver-age score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
I:												
1946-58.....	8	9	Sept. 26	22.3	0.65	3.34	13.0	0.67	2.5	0.02	8.7	77.4
II:												
1946-58.....	2	2	Oct. 10	21.9	0.60	3.35	12.8	0.53	2.3	0.01	11.5	75.8
IV:												
1946-58.....	4	4	Sept. 6	21.1	0.72	3.28	11.4	0.63	2.2	0.04	16.3	73.7

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.  
† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.



ducer (average, 3.3 tons per acre in five years at Oakville). Consequently, it would have to depend on high quality for competing with other varieties. This variety deserves consideration for small plantings, and further work should be done to establish whether or not it is the same as our Pinot blanc. Virus-free clones may be imported, or obtained by treatment. Analytical data are given in table 21.

*Merlot:* This variety is being planted more in the Bordeaux region of France because of its productivity and the early maturing of its wines. It has never been grown commercially to any extent in California, but it has many favorable characteristics. The vines are excellent producers; the musts are of good quality, particularly in Regions I and II; the wines have a distinct Cabernet-like flavor, and have usually scored high in our tests. The analytical data in table 22 show that Merlot ripens adequately and has a moderately

TABLE 22. COMPOSITION OF MUSTS AND WINES OF MERLOT

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color inten-sity*	Aver-age score†
				<i>degrees</i>	<i>gm/100cc</i>		<i>per cent vol.</i>	<i>gm/100cc</i>	<i>gm/100gm</i>	<i>gm/100cc</i>		
I:												
1935-41.....	1	1	Sept. 25	21.4	0.47	3.19	11.5	.....	2.4	0.19	270	.....
1946-58.....	3	3	Sept. 25	23.4	0.62	3.33	12.4	0.58	2.8	0.14	367	77.5
II:												
1946-58.....	2	2	Oct. 10	24.2	0.60	3.40	13.2	0.66	3.2	0.11	258	78.0
IV:												
1935-41.....	3	3	Sept. 19	22.8	0.45	3.54	11.4	0.38	2.3	0.13	191	.....
1946-58.....	2	2	Oct. 15	21.5	0.52	3.60	10.3	0.39	2.8	0.11	106	71.2

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.  
† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

good acidity in Regions I and II. It is recommended for pilot plantings in Regions I and II, and possibly in Region III, for production of an above-average quality Cabernet-type wine.

For a recent history and description of Merlot, see Cosmo and Polsinelli (1957*b*), who note its popularity in northern Italy because of its productivity and moderate quality. As with Cabernet franc, in the regions in which these workers tested it, the sugar content varied widely—14.7 to 24.8, average, 20.2 (78 musts). They note its characteristic flavor, also its tendency to be low in acid and not to age very well. They recommend it for an early-maturing wine.

*Mission:* Probably the oldest of the varieties grown commercially in California, Mission has certainly been tried for a sufficient period of time to indicate its position in the state's wine industry. Previous reports show that

it should not be used, under any conditions, for the production of table wines. Its dessert wines have usually scored well. The present study reports only on its use for dessert wines. The production of Mission is good—6 to 12 tons per acre at Davis. Its analytical data (table 23) do not rule it out as a dessert-wine variety although it is rather low in acidity and high in pH in Regions

TABLE 23. COMPOSITION OF MUSTS AND WINES OF MISSION

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†
				degrees	gm/ 100cc		per cent vol.	gm/ 100cc	gm/ 100gm	gm/ 100cc		
I:												
1935-41.....	2	2	Oct. 12	22.9	0.47	3.45	18.0	0.33	12.3	0.06	37	....
II:												
1935-41.....	3	3	Sept. 24	24.5	0.35	3.58	20.0	0.30	11.8	0.02	10	....
III:												
1935-41.....	3	3	Sept. 28	24.1	0.44	3.59	20.0	0.34	13.8	0.03	8	....
IV:												
1935-41.....	5	13	Oct. 7	25.0	0.46	3.80	18.3	0.33	13.7	0.07	56.4	....
1946-58.....	8	11	Oct. 25	24.1	0.56	3.70	19.2	0.38	14.0	0.04	14.8	75.0
V:												
1935-41.....	2	3	Oct. 8	26.2	0.38	3.87	18.7	0.23	11.7	0.04	18.0	....
1946-58.....	1	3	Sept. 5	24.1	0.40	3.66	20.0	0.30	13.7	0.02	8.7	77.0

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

IV and V, probably because of its late ripening. Mission is probably the equal of most other varieties that could be recommended for the production of white sweet wines in Regions IV and V. One objection to Mission is that the juice must be taken off the skins rapidly to prevent too much extraction of color. In spite of this, the musts are sometimes considerably darker than those from white varieties, a characteristic that limits this grape's usefulness in making the newer type of light-colored, flavored wine. It would therefore be unwise to make new plantings of Mission, but present plantings can be utilized for the production of white sweet dessert wine.

*Muscat Canelli*: This variety is also grown commercially in California under the name Muscat Frontignan. Its correct name is probably simply Muscat blanc. It has been tested in the state for many years, both experimentally and commercially, and the general opinion is that it produces a superior quality white dessert wine, whether planted in Region I or Region V. The requirements for the acidity are not so specific for a dessert wine as for a table wine. However, even in the warmer regions, the musts of this variety have not been badly balanced in so far as the acidity and pH are concerned. Because of sunburn, however, it probably should not be planted in Region V since it is an early-ripening variety that will mature adequately



in cooler regions. One of the objections to the variety is its relatively low production. Over a 14-year period it has averaged 4.4 tons per acre at Davis, with a 5.5 maximum. Because of its intense muscat flavor, however, it has been planted commercially in a number of vineyard areas. Analytical data on the dessert wines made from Muscat Canelli are given in table 24.

TABLE 24. COMPOSITION OF MUSTS AND WINES OF MUSCAT CANELLI

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†
				degrees	gm/ 100cc		per cent vol.	gm/ 100cc	gm/ 100gm	gm/ 100cc		
White sweet												
I:												
1946-58.....	6	6	Oct. 7	25.3	0.63	3.40	20.1	0.47	13.8	0.03	11.7	78.3
II:												
1935-41.....	1	1	Sept. 21	26.5	0.53	3.22	19.8	0.31	14.1	0.03	39	....
III:												
1935-41.....	1	1	Sept. 19	25.3	0.62	3.25	18.5	0.41	13.4	0.06	37	....
IV:												
1935-41.....	2	5	Sept. 23	27.0	0.48	3.48	18.3	0.40	11.6	0.05	63	....
1946-58.....	11	15	Oct. 1	24.6	0.67	3.53	19.0	0.48	13.1	0.03	16.9	77.2
V:												
1935-41.....	5	8	Aug. 17	25.6	0.48	3.71	17.5	0.32	12.9	0.05	31	....
1946-58.....	7	7	Aug. 26	24.8	0.62	3.44	18.4	0.46	13.1	0.04	26	75.9
Dry white												
III:												
1935-41.....	2	2	Sept. 19	21.0	0.68	3.31	11.4	0.58	3.6	0.05	18.5	....
IV:												
1935-41.....	1	3	Sept. 19	23.2	0.73	3.42	12.5	0.55	2.5	0.03	9.0	....
1946-58.....	9	9	Sept. 21	22.8	0.74	3.43	12.3	0.53	3.3	0.03	18.9	73.3
V:												
1935-41.....	2	4	Aug. 24	24.4	0.72	3.65	12.9	0.47	4.1	0.07	....	....

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

This variety has also been tested in a limited way for the production of a natural sweet white wine. The grapes have to be specially harvested for this purpose, to insure that they have adequate sugar. Grapes from Regions I to III appear to be somewhat better than those from the warmer regions. The dry white wines have a distinct muscat character but, like all dry, muscat-flavored table wines, they are somewhat bitter. In limited tests, this variety has produced a high-quality, muscat-flavored sparkling wine. However, the wine should be well sweetened (up to about 5 per cent) after disgorging.

*Muscat of Alexandria*: Because this variety has been studied so intensively over a long period of time, very little work has been done on it here since World War II. It is primarily a raisin grape, and in many instances its musts and wines are not of satisfactory quality for a superior dessert wine. Furthermore, its tendency to raisin on the vine frequently leads to muscatels with a caramelized flavor. A Malaga-type wine might possibly find a place in the California industry, as it has in Spain, but so far no raisin-flavored dessert wines have achieved consumer acceptance in this state. The variety has

TABLE 25. COMPOSITION OF MUSTS AND WINES OF MUSCAT OF ALEXANDRIA

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†
				degrees	gm/ 100cc		per cent vol.	gm/ 100cc	gm/ 100gm	gm/ 100cc		
Sweet												
II:												
1935-41.....	2	2	Oct. 7	24.8	0.45	3.59	19.1	0.36	14.0	0.03	16	....
IV:												
1935-41.....	3	12	Oct. 14	25.4	0.43	3.79	18.6	0.30	12.9	0.03	20	....
V:												
1935-41.....	4	6	Sept. 12	24.9	0.44	3.97	18.2	0.30	13.0	0.03	52.5	....
Dry												
IV:												
1935-41.....	4	16	Oct. 19	23.4	0.50	3.60	13.1	0.35	2.3	0.03	25.6	....
1946-58.....	2	4	Oct. 5	21.6	0.60	3.50	12.4	0.46	2.3	0.02	19.6	71.8
V:												
1946-58.....	1	5	Sept. 29	19.8	0.53	3.54	11.4	0.40	....	....	....	72.2

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

been tried a number of times for dry white wine (table 25), but the wines are usually flat and bitter in taste and very subject to bacterial spoilage. The Muscat of Alexandria will continue to be used for making of muscatel wines because of the large acreage available in Region V. However, better flavored Muscat varieties should be planted in preference to the Muscat of Alexandria if a market for quality muscatel wines develops.

*Orange Muscat*: This variety has now been extensively tested in Regions IV and V. In most cases it has produced average-quality wines, but at its best, the wines have been outstanding. However, the wine is somewhat subject to oxidation. Orange Muscat is an average but not outstanding producer. At Davis the 14-year average was 6.6 tons per acre, with a maximum of 10. The fruit arrived at the winery in excellent condition, but a little too

pulpy for the highest juice yields. Nevertheless, the pulpiness is less than that of varieties such as Palomino and many of the table grapes. The musts have fairly good composition even at high sugar contents, and the wines are of very pleasing muscat aroma (table 26). The variety has also been tried for a dry white wine and as a possible sparkling wine base. Unfortunately, in only one test was it picked early enough to give a properly balanced must for a sparkling wine. In that instance it produced an agreeable sparkling wine which was particularly good when sweetened. There have been some reports of its failure to produce regularly in southern California, but this has not been noticed in the University vineyard at Davis nor in the vineyards in which it is planted near Delano. This variety seems to deserve further trial plantings by growers in the San Joaquin Valley, for use in the production of a high quality muscatel. Amerine (1951*b*) also recommended it but noted some tendency to overproduction when underpruned.

TABLE 26. COMPOSITION OF MUSTS AND WINES OF ORANGE MUSCAT

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†
				degrees	gm/ 100cc		per cent vol.	gm/ 100cc	gm/ 100gm	gm/ 100cc		
IV:												
1935-41.....	5	8‡	Oct. 3	26.4	0.52	3.83	19.3	0.35	13.4	0.05	60	....
1946-58.....	7	9‡	Oct. 9	25.5	0.60	3.77	19.5	0.42	13.6	0.05	16.1	76.4
V:												
1935-41.....	2	2‡	Aug. 18	25.2	0.48	3.60	19.2	0.36	13.9	0.06	62	....
1946-58.....	4	6‡	Sept. 2	24.0	0.61	3.65	19.5	0.42	10.9	0.02	27.1	75.9
IV:												
1946-58.....	6	6§	Sept. 27	24.2	0.66	3.72	12.8	0.50	2.6	0.03	21.8	72.3
V:												
1946-58.....	1	2§	Sept. 26	20.5	0.55	3.65	11.5	0.46	2.5	0.01	6.5	75.3

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.  
† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.  
‡ Sweet.  
§ Dry.

*Petite Sirah* (California): This variety has been tested in all the regions of California, over a long period of time. It is a moderately good producer, with a 12-year average of 7.7 tons per acre, at Davis, and a maximum of 10.5. At Oakville, over a five-year period, it has averaged 5.3 tons per acre. It is subject to rain damage and mold rot in the cooler regions in the more humid years, and to sunburn in the hotter regions. It is unlikely that the *Petite Sirah* would have survived in California for so long if it had not produced a standard quality wine with a good, red color. It is widely used for bringing up the color of other varieties, as can be seen from table 27.

The grapes of this variety are easy to handle in the winery. When they arrive in good condition, they may easily be made into a standard red wine. Because of its high tannin content, the wine should not be left on the skins



TABLE 27. COMPOSITION OF MUSTS AND WINES OF PETITE SIRAH

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†
				<i>degrees</i>	<i>gm/ 100cc</i>		<i>per cent vol.</i>	<i>gm/ 100cc</i>	<i>gm/ 100gm</i>	<i>gm/ 100cc</i>		
California												
I:												
1935-41.....	6	14	Oct. 8	21.9	0.76	3.29	12.2	0.64	2.7	0.25	658	....
1946-58.....	8	10	Oct. 9	22.1	0.71	3.28	12.1	0.77	3.1	0.21	616	76.0
II:												
1935-41.....	7	35	Oct. 3	22.5	0.63	3.42	12.6	0.55	2.8	0.20	729‡	....
1946-58.....	3	5	Oct. 3	22.1	0.87	3.32	11.4	0.72	3.0	0.19	598	75.6
III:												
1935-41.....	7	40	Sept. 24	23.6	0.63	3.61	12.9	0.58	3.0	0.23	848‡	....
1946-58.....	3	5	Sept. 23	21.8	0.74	3.30	11.9	0.69	2.9	0.21	449	75.3
IV:												
1935-41.....	7	41	Oct. 1	24.3	0.65	3.62	12.7	0.46	3.0	0.20	432	....
1946-58.....	9	16	Sept. 27	21.3	0.71	3.54	10.6	0.58	3.1	0.18	342	74.1
V:												
1935-41.....	6	12	Aug. 29	22.7	0.62	3.74	11.3	0.50	2.8	0.21	411	....
French												
I:												
1946-58.....	5	5	Oct. 3	22.8	0.73	3.18	12.4	0.82	3.3	0.15	477	76.8
IV:												
1946-58.....	7	8	Sept. 27	21.6	0.64	3.55	11.2	0.61	3.5	0.19	364	75.4

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

‡ Raised by the high color in 1936.

too long, unless it is to be aged in small cooperage for a long time. Both standard and some superior wines have been made from this variety from Region II, and this is probably the region of preference at present. However, we have occasionally made good wines from Petite Sirah in Region III and even IV. The variety will continue to exist in our vineyards, but it is doubtful that extensive new plantings will be made except by vineyardists in the competitive field of standard wines.

*Petite Sirah* (French): This variety, which has been extensively tested in Regions I and IV, is the French selection that was imported to California in 1939 by Olmo. In all of the tests it has been compared with the California *Petite Sirah*.

Not so good a producer as the California variety, it averaged 3.2 tons per acre over a five-year period at Oakville, as compared with 5.3 tons per acre for the California strain in the same vineyard and at the same age.

The data in table 27 indicate that this selection is better adapted to Region I than to Region IV. In Region I, it has a much better pH and total acidity,



ripens adequately, and makes a wine of above average quality. Some evidence indicates that this variety does not sunburn so easily as our California strain. Furthermore, because of its looser clusters it is somewhat more resistant to mold, following an early rainfall. On the other hand, it must be recognized that this variety does not mature early and that it requires considerable barrel aging to reach its highest quality. Furthermore, it is not a particularly distinctive type of wine, and would therefore need a period of familiarization before being accepted by the public.

A dedicated grower, willing to age the wine properly both in the wood and in the bottle, might produce a high-quality wine that would bring a price sufficient to compensate for the time spent.

*Pinot blanc*: This is the true Pinot blanc, and it has been extensively tested in California for many years. (The wines sold as White Pinot in the trade are usually not made from Pinot blanc grapes, but from Chenin blanc.) The report of Amerine and Winkler (1944) that Pinot blanc was grown in the Chablis region of France is apparently incorrect, and arose through the fact that the Chardonnay grape sometimes has a local synonym of Pinot blanc.

Pinot blanc is a low producer. Consequently, its success will have to depend on the high quality of its wines. At Davis, over a 15-year period, it has averaged 4.9 tons per acre, with a maximum of 7.3. It is apparent from the must analysis that this variety is better adapted to cooler regions of the state, particularly to I and II. In such regions, however, it may be subject to bunch rot because of the very tight clusters. But a more important disadvantage is the high tannin content of the skins, which inevitably gets into the must and hence into the wines. Table 28 indicates that the tannin content of young

TABLE 28. COMPOSITION OF MUSTS AND WINES OF PINOT BLANC

Region and years	No. of years sam- ples taken	No. of sam- ples	Average date of harvest	Must			Wine					
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†
I:				degrees	gm/ 100cc		per cent vol.	gm/ 100cc	gm/ 100gm	gm/ 100cc		
1935-41.....	2	2	Sept. 10	23.2	0.70	3.22	12.5	0.51	2.1	0.04	23.0	....
1946-58.....	11	19	Oct. 2	21.4	0.76	3.23	12.2	0.72	2.5	0.04	9.6	75.3
II:												
1946-58.....	4	8	Sept. 27	22.5	0.72	3.31	13.0	0.63	2.4	0.03	9.0	75.8
III:												
1935-41.....	5	5	Sept. 23	22.2	0.72	3.40	11.5	0.49	2.3	0.03	17.0	....
1946-58.....	4	5	Sept. 21	22.0	0.82	3.32	12.1	0.73	2.4	0.03	13.2	75.0
IV:												
1935-41.....	7	16	Sept. 4	22.1	0.65	3.50	11.9	0.50	2.4	0.04	19.0	....
1946-58.....	12	17	Sept. 22	21.9	0.67	3.54	12.5	0.50	2.6	0.03	13.6	75.0
V:												
1935-41.....	4	4	Aug. 18	23.5	0.48	3.73	13.5	0.49	2.8	0.04	12.8	....

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

Pinot blanc wines is at least 0.01 to 0.02 grams per 100 ml higher than that of other white wine grape varieties. Cosmo and Polsinelli (1959a), in their history and description of the Pinots, reported tannin contents of 0.01 to 0.05 per cent (average, 0.02). In the warmer regions the musts are too high in pH and too low in total acidity. In all regions there is a tendency to darken, which was also noted by Berg and Akiyoshi (1956) in their accelerated aging studies.

On the credit side, the variety is recognized as having good sugar and good acidity in the cooler regions. The wines are flavorful and develop a good bouquet.

The Pinot blanc does not warrant further testing in this state, and it should be planted only by those who want to produce a very special type of white wine to which they will pay considerable attention to prevent darkening. Analytical data are given in table 28.

*Pinot noir*: The famous wines of Burgundy are produced largely from this variety, which accounts for its having been tested by all previous investigators in California, and in many new viticultural regions of the world. At the California Agricultural Experiment Station, Pinot noir was tried at least as early as 1885. Results of the tests, over the years, have been remarkably similar, and have led to only a lukewarm recommendation of this variety for planting in California.

Pinot noir has several disadvantages. It is a very early ripener and a low producer, with many clones that have only a moderate amount of color. When these clones are grown in Regions III, IV, or V, they produce only pink wines. Actually, very few straight Pinot noir wines produced experimentally have revealed the full potentiality of the variety—the full, ripe-grape aroma that is expected in a proper French Burgundy. Possibly, under California conditions, the variety develops less Pinot character, just as it often has too little color. Furthermore, it must be picked under conditions that do not permit fermentation to be continued for a sufficiently long period on the skins. One unusual characteristic of Pinot noir is the tendency of its musts to undergo a malo-lactic fermentation. No doubt some malo-lactic fermentation is desirable in this variety, but the acidity should not be reduced to a level at which the wine will taste very flat. The analyses show that a strong malo-lactic fermentation took place in both the 1935–1941 and the 1946–1958 Pinots from Region IV.

Production at Davis has been variable, depending on the method of pruning the vines and the care given to the grapes. For a 13-year period, production averaged 3.7 tons per acre, with a maximum of 5.9. Mature vines at Oakville averaged 3.9 tons per acre during a three-year period.

The musts of Pinot noir are well balanced in Regions I and II, but are high in pH in Regions IV and V. In 16 samples of wine from northern Italy, Cosmo and Polsinelli (1959a) found that the total acidity varied from 0.47 to 0.86 (average, 0.63) grams per 100 cc for alcohols of 9.5 to 14.3 (average, 12.1).

Growers should be certain that they have a market before planting Pinot noir, and should plant in the cooler locations of Region I. Winemakers should take special care to pick the grapes at the proper time, to ferment them so that maximum color is extracted, and to hold them so that they do not undergo excessive malo-lactic fermentation. Amerine (1949) suggested great care in identifying the variety, and use of either small cooperage or temperature control for fermentation as a means of improving wines from this variety. Analytical data are given in table 29.

TABLE 29. COMPOSITION OF MUSTS AND WINES OF PINOT NOIR

Region and years	No. of years sam- ples taken	No. of sam- ples	Average date of harvest	Must			Wine					
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†
I:				<i>degrees</i>	<i>gm/ 100cc</i>		<i>per cent vol.</i>	<i>gm/ 100cc</i>	<i>gm/ 100gm</i>	<i>gm/ 100cc</i>		
1935-41.....	2	3	Sept. 19	22.6	0.70	3.28	12.2	0.64	2.9	0.18	268	....
1946-58.....	6	16	Sept. 13	22.9	0.76	3.30	12.7	0.68	2.9	0.09	165	76.5
II:												
1946-58.....	3	4	Sept. 7	22.6	0.94	3.30	12.2	0.72	2.7	0.11	82	75.6
IV:												
1935-41.....	3	5	Aug. 21	22.6	0.84	3.40	10.6	0.47	2.9	0.11	123	....
1946-58.....	12	15	Sept. 13	22.4	0.86	3.47	11.6	0.56	3.1	0.08	102	73.5
V:												
1935-41.....	2	2	Aug. 29	23.9	0.43	3.67	12.4	0.41	2.8	0.12	105	....
1946-58.....	3	3	Aug. 31	23.3	0.67	3.63	11.8	0.50	2.9	0.06	69	74.8

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

*Raboso Piave:* Cosmo and Polsinelli (1955a) have described Raboso Piave. They found it to be a vigorous and productive variety but of late maturity. When fermented on the skins, the wine had an intense color and a rough taste. With aging, a fair table wine was produced. These findings do not agree with our experience.

TABLE 30. COMPOSITION OF MUSTS AND WINES OF RABOSO PIAVE

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†
				<i>degrees</i>	<i>gm/ 100cc</i>		<i>per cent vol.</i>	<i>gm/ 100cc</i>	<i>gm/ 100gm</i>	<i>gm/ 100cc</i>		
IV:												
1935-41.....	5	5	Oct. 16	22.9	1.01	3.20	10.5	0.63	3.0	0.17	267	....
1946-58.....	6	6	Oct. 13	21.4	1.15	3.15	9.7	0.80	3.6	0.18	503	70.9
V:												
1935-41.....	2	2	Sept. 24	21.0	0.70	3.25	11.0	0.61	2.7	0.23	247	....

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.



This variety was tested mainly in Regions IV and V, both before and after World War II. It is very late in ripening, and consequently has normally not been picked until mid-October, even in a region as warm as Davis. Even at that late date the grapes have not been very ripe, the acidity has generally been high, and the resulting wines have been only moderate in alcohol content and have undergone varying degrees of malo-lactic fermentation.

Raboso Piave is a poor producer. In five-year trials at Davis it averaged 2.6 tons per acre, with a maximum of 4.7. It is certain that this variety should not be planted in regions cooler than Region IV. It may find a limited place for the production of a sound wine in Region V, but since it is not a high producer it is obviously not in a very favorable position to compete economically with other varieties of equal flavor. No further tests of this variety are recommended nor are plantings recommended anywhere except under very special conditions in Region V. Analytical data are given in table 30.

*Red Veltliner* and *Red-white Veltliner*: Although these seem to be separate varieties, they are only strains of the same variety, and they have similar

TABLE 31. COMPOSITION OF MUSTS AND WINES OF RED VELTLINER AND RED-WHITE VELTLINER

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†
				degrees	gm/ 100cc		per cent vol.	gm/ 100cc	gm/ 100gm	gm/ 100cc		
Red Veltliner												
I:												
1935-41.....	5	7	Oct. 2	21.6	0.63	3.35	12.0	0.54	2.3	0.05	13.7	....
1946-58.....	5	5	Sept. 23	23.0	0.69	3.34	12.9	0.64	3.2	0.02	8.2	75.3
II:												
1935-41.....	5	9	Sept. 24	23.0	0.59	3.47	12.5	0.49	2.5	0.03	13.8	....
III:												
1935-41.....	3	3	Sept. 13	23.5	0.61	3.59	12.1	0.51	2.4	0.02	13.5	....
IV:												
1935-41.....	2	2	Aug. 18	19.7	0.72	3.37	10.3	0.52	2.3	0.02	8.0	....
Red-white Veltliner												
I:												
1946-58.....	1	1	Sept. 25	25.6	0.57	3.30	14.8	0.76	2.7	0.03	9.0	76.0
II:												
1946-58.....	1	1	Sept. 25	19.5	0.84	3.30	11.1	0.92	2.6	0.03	12.0	77.0
III:												
1946-58.....	2	2	Sept. 25	20.2	0.70	3.35	11.1	0.65	2.4	0.03	25.0	73.2
IV:												
1948-58.....	5	7	Sept. 15	21.9	0.68	3.48	12.2	0.56	2.5	0.03	15.1	74.4

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.



viticultural and enological properties. Analytical data are given in table 31. At Davis they are moderate producers, averaging 3.5 tons per acre, with a maximum of 6.8. At Oakville, on the other hand, the five-year average is 5.1 tons per acre, with a maximum of 7.0.

It will be seen that neither variety is a high producer, but both are certainly above average in production in the Napa Valley. The clusters are large and very easily harvested—an advantage from the picker's point of view. It is possible to overcrop these varieties and thus have unbalanced musts, but generally speaking the musts have been of fairly good quality except when the grapes were picked very late in one of the warmer regions.

These varieties have a very slightly distinctive flavor, particularly when they are fermented at low temperature, but they have never produced very distinctive wines in the tests that have been made. The recommendation of Amerine and Winkler (1944) is therefore probably correct—the Veltliners are useful varieties for producing standard wines for early maturity in Region II. They should not be planted in Region IV and it is questionable if they should be planted in Region I.

*Refosco*: This variety was tested by Hilgard and Bioletti. Bioletti (1908) and Amerine and Winkler (1944) recommended it, but apparently confused it with the Mondeuse. It now appears that Refosco and Mondeuse are probably the same variety, and the recommendations and comments of Amerine and Winkler could, with minor exceptions, be used interchangeably for the two. Production is moderate, averaging 4.4 tons per acre, with a maximum of 7.3, in over eight years at Davis. However, Refosco should not be planted in too-warm regions because the fruit grows rather exposed to the sun, and

TABLE 32. COMPOSITION OF MUSTS AND WINES OF REFOSCO

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†
				degrees	gm/ 100cc		per cent vol.	gm/ 100cc	gm/ 100gm	gm/ 100cc		
I:												
1935-41.....	3	3	Oct. 16	21.6	0.62	3.46	11.9	0.54	2.8	0.26	257	....
1946-58.....	1	1	Oct. 5	20.0	0.75	3.20	9.5	0.69	2.4	0.21	333	74.5
II:												
1935-41.....	1	1	Oct. 1	24.6	0.65	....	12.9	0.49	2.2	0.16	....	....
1946-58.....	1	1	Sept. 25	22.9	0.85	3.30	11.4	0.79	3.2	0.16	500	75.0
III:												
1946-58.....	1	1	Sept. 25	23.2	0.87	3.30	12.6	0.84	3.4	0.27	400	77.0
IV:												
1935-41.....	6	16	Oct. 2	22.0	0.60	3.50	11.2	0.56	2.8	0.20	258	....
1946-58.....	4	6	Sept. 20	18.8	0.61	3.34	9.3	0.59	2.6	0.16	290	71.8
V:												
1935-41.....	1	1	Sept. 6	22.4	0.70	....	10.9	0.60	2.5	0.27	....	....

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

sunburn can result. Its musts have had a good balance in most of the regions in which it has been grown, and its wines have been of standard but never of outstanding quality. Because of its good color it has been much used as a blending grape.

Refosco is probably useful for blending when it is desired to reduce the intensity of the Cabernet flavor in Cabernet Sauvignon. However, this practice is probably unnecessary if the Cabernet Sauvignon is picked at optimum maturity, and given a sufficiently early pressing to secure early maturation of the wine. It is doubtful that Refosco is desirable for California vineyards except as a blending grape of good acidity and color in Regions I, II, or III. Further testing is not recommended. Analytical data are given in table 32.

*Ruby Cabernet:* This variety was produced by Olmo (1948), who noted that it is a cross of Cabernet Sauvignon and Carignane, and that it has a very high production potential and a very distinctive Cabernet aroma.

Average production at Davis for a six-year period was 7.9 tons per acre; at Oakville, for a five-year period, it was 5.1. When these figures are compared with those for Cabernet Sauvignon, the higher potential yield of Ruby Cabernet is apparent. There is also no doubt that the variety has a good acidity and excellent color even when grown in Regions IV and V.

Two problems have arisen with this variety. When it is grown in Regions I, II, or III, the tannin content of the wine is rather high, and this has led to wines that are rough and difficult to age. Consequently, most of the Ruby Cabernet wines have been blended out into low-tannin wines rather than aged for their own sake. (Sunburning was observed in one instance in a Region III vineyard after a very hot spell, but this would probably not happen very often.) However, Ruby Cabernet is still the variety of choice for red table wines for Regions III and IV, where its flavor is distinctive and where, if it is properly fermented, it is not too high in tannin. Analytical data are given in table 33.

TABLE 33. COMPOSITION OF MUSTS AND WINES OF RUBY CABERNET

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†
				degrees	gm/ 100cc		per cent vol.	gm/ 100cc	gm/ 100gm	gm/ 100cc		
I:												
1946-58.....	6	10	Oct. 11	21.8	0.85	3.28	11.4	0.82	3.2	0.25	672	76.2
II:												
1946-58.....	4	4	Sept. 30	21.4	1.02	3.20	11.0	0.83	3.1	0.17	559	77.4
IV:												
1946-58.....	8	22	Sept. 28	22.5	0.92	3.43	11.5	0.70	3.3	0.18	489	76.0
V:												
1946-58.....	3	3	Aug. 28	19.0	0.90	3.43	9.6	0.63	2.9	0.12	142	74.8

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines

*Salvador*: This variety is a direct-producing hybrid of *Vitis rupestris* and *V. vinifera*. Plantings of *Salvador* were developed in the San Joaquin Valley because highly colored red wine grape varieties were lacking. *Salvador* has a rather intense color (table 34) which can easily be extracted by heat or fermentation and then used to add color to other types of wine. Because the color is so intense, even a small amount of *Salvador* will add color to a very large amount of wine. Unfortunately, the color is not very desirable because it is bluish-red rather than full red, and in blends it is only moderately stable.

Straight *Salvador* wines can lose up to two thirds of their color and still be considered of rather high color. Their main disadvantage, however, is a rather unpleasant aroma, and they cannot be drunk straight because of their high tannin content.

Although not a vigorous variety, *Salvador* is a high producer—a seven-year average of 9.7 tons per acre at Davis. It can be induced to overcrop, by long pruning, but this is detrimental to the coloring. Since the clusters are small, they are rather expensive to harvest.

Development of a pure *vinifera* of sufficient color to be used in the same way as *Salvador* would be desirable. (The new varieties *Royalty* and *Rubired* (Olmo and Koyama, 1962), which have recently been released, should prove useful as a source of color.)

Analytical data are given in table 34.

TABLE 34. COMPOSITION OF MUSTS AND WINES OF SALVADOR

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†
				degrees	gm/ 100cc		per cent vol.	gm/ 100cc	gm/ 100gm	gm/ 100cc		
I: 1935-41.....	1	1	Oct. 5	25.8	0.69	3.88	15.7	0.66	3.8	0.39	3,330	....
II: 1935-41.....	2	2	Sept. 22	24.5	0.85	3.34	12.9	0.69	2.9	0.35	2,500	....
III: 1935-41.....	1	1	Oct. 2	21.7	0.68	....	10.5	0.64	2.9	0.25	....	....
IV: 1946-58.....	7	7	Sept. 23	22.4	0.90	3.46	11.4	0.82	3.7	0.24	939	73.0
V: 1935-41.....	3	3	Aug. 21	23.4	0.67	3.19	11.3	0.66	3.4	0.33	3,270	....

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

*Sauvignon blanc*: This variety is widely planted in the state, and is generally recognized as one of the finer grape varieties for California conditions. It has been tested for the past 80 years. Production is not so low as generally believed. During 15 years at Davis, yield averaged 5.8 tons per acre, with



a maximum of 8. At Oakville, both a young block and a very old block averaged 6.4 tons per acre over a five-year period. When the vines are young, production is not high, but the vine is vigorous and can carry a large crop as its framework becomes larger. It should be cane-pruned in order to secure the maximum crops, but it should not be overcropped because, in such cases, it does not tend to develop its full varietal aroma.

Sauvignon blanc ripens well. Under some conditions the fruit tends to become too ripe. Such fruit should be used for a sweet rather than a dry table wine. Even in the warmer regions it does not have too low a total acidity when it is picked at the proper time.

Little can be added to our previous recommendations that it is a desirable variety for the production of high quality white table wines in Regions I, II, and III.

For a recent history and description of Sauvignon blanc, see Cosmo and Polsinelli (1958c). They report must sugars, in 16 samples, of 18.2 to 25.0 (average, 21.4), with an acidity of 0.35 to 0.89 (average 0.56). They also note the wine's distinctive flavor—sometimes thought to be too pronounced. The tendency to easy oxidation (*marsaleggia*) indicated must have resulted from using grapes attacked by botrytis, since this reaction does not normally occur in California wines. Analytical data are given in table 35.

TABLE 35. COMPOSITION OF MUSTS AND WINES OF SAUVIGNON BLANC

Region and years	No. of years sam- ples taken	No. of sam- ples	Average date of harvest	Must			Wine					
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†
				<i>degrees</i>	<i>gm/ 100cc</i>		<i>per cent vol.</i>	<i>gm/ 100cc</i>	<i>gm/ 100gm</i>	<i>gm/ 100cc</i>		
I:												
1935-41.....	1	1	Sept. 25	24.1	0.74	3.30	13.8	0.58	2.4	0.02	23.0	....
1946-58.....	8	14	Sept. 29	23.0	0.85	3.24	12.6	0.87	3.2	0.03	9.7	75.9
II:												
1935-41.....	4	4	Sept. 30	25.9	0.63	3.18	14.7	0.54	2.6	0.05	18.3	....
1946-58.....	7	10	Oct. 3	24.2	0.79	3.33	12.6	0.68	2.5	0.02	13.1	75.6
III:												
1935-41.....	5	7	Sept. 10	25.0	0.66	3.38	13.5	0.58	2.6	0.03	21.0	....
1946-58.....	4	6	Sept. 23	23.7	0.76	3.43	13.4	0.65	2.5	0.04	13.8	76.8
IV:												
1935-41.....	4	13	Sept. 24	23.3	0.75	3.37	13.3	0.59	2.9	0.04	21.0	....
1946-58.....	11	27	Sept. 22	23.6	0.84	3.44	13.3	0.67	2.9	0.03	17.1	74.9
V:												
1935-41.....	1	1	Aug. 15	22.9	0.79	3.35	12.5	0.62	2.6	0.06	12.0	....
1946-58.....	2	2	Aug. 30	23.1	0.60	3.40	13.7	0.60	2.3	0.03	7.5	72.8

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

*Sémillon*: Widely planted in California, *Sémillon* is recommended as one of our better varieties. It has been extensively tested both here and abroad, and can be recommended for production of standard and slightly above standard dry white wines.



In good soils, Sémillon is a good producer. Over a 13-year period at Davis, it averaged 6.4 tons per acre, with a maximum of 10.2. During five years at Oakville, production averaged 3.9 tons per acre, with a maximum of 5.9.

The best Sémillons have been those from properly cropped vines. The berries are large, very yellow, and, under the most favorable conditions, russet or pink in color at harvest. Overcropped vines have green fruit, and where cropping is extreme, the apical parts of the clusters tend to shrivel.

The berries are thin-skinned and must be handled carefully, especially late in the season, if they are to arrive at the crusher in good condition. (A small gondola truck would probably be desirable for harvesting Sémillon grapes.) Crushing is not difficult, and fermentations and clarifications are quite normal.

In the cooler regions, Sémillon has a good sugar-acid balance, and produces very well-balanced wines. These have a very distinctive, easily recognizable, specific varietal aroma, especially when they are made from properly ripened fruit. Some find the flavor a little strong and coarse, but a taste may be acquired for this, one of our most distinctive varieties. In the warmest years, Sémillon can get sweet enough to be used as a base for a sweet table wine.

Our earlier recommendation for planting (Amerine and Winkler, 1944) is still valid: Sémillon is particularly adapted to Regions II and III. It should not be planted in Region V and certainly not, in most cases, in Region I. It can be grown in Region IV, but planting is not recommended. In Region V it tends to sunburn and it ripens early, with a low acidity. In Region I it is subject to bunch rot. During the very wet 1957 season in California, Sémillon

TABLE 36. COMPOSITION OF MUSTS AND WINES OF SÉMILLON

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Balling	Total acid	pH	Alcohol	Fixed acid	Extract	Tannin	Color intensity*	Average score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
I:												
1935-41.....	7	18	Oct. 5	22.4	0.64	3.22	12.4	0.56	2.3	0.03	17.6	.....
1946-58.....	9	10	Oct. 2	22.3	0.68	3.38	12.8	0.68	2.9	0.03	14.9	74.4
II:												
1935-41.....	6	15	Oct. 6	24.2	0.48	3.51	13.2	0.44	2.7	0.03	16.5	.....
1946-58.....	5	11	Sept. 28	20.7	0.72	3.34	11.5	0.67	2.6	0.03	11.5	75.3
III:												
1935-41.....	7	18	Sept. 22	23.8	0.52	3.47	12.3	0.45	2.8	0.03	19.7	.....
1946-58.....	6	12	Sept. 21	23.0	0.66	3.44	12.9	0.58	2.5	0.02	10.0	75.0
IV:												
1935-41.....	7	30	Sept. 30	23.0	0.52	3.62	12.6	0.42	3.3	0.04	22.0	.....
1946-58.....	9	15	Sept. 30	22.2	0.59	3.61	12.1	0.58	2.5	0.04	19.1	74.5
V:												
1935-41.....	6	9	Aug. 21	22.2	0.50	3.50	12.1	0.43	2.7	0.04	24.6	.....
1946-58.....	7	11	Aug. 17	22.0	0.61	3.53	11.8	0.58	2.9	0.02	18.9	74.6

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

was heavily attacked by botrytis, but the berries did not dry on the vines because of the high humidity. This susceptibility limits planting to the drier locations of Regions II and III.

For further data on the variety, see Winkler and Olmo (1937*b*); for information on vinification, see Amerine (1949); and for a more recent history and description, see Cosmo and Polsinelli (1959*b*). The latter found that, in Italy, Sémillon wines oxidized easily, probably because of botrytis.

Analytical data are given in table 36.

*Souzão*: This variety was imported into California by Olmo, and has been extensively tried in both Regions IV and V. The only previous report on this variety (Amerine, 1955) recommended it, because of its high color and acidity, for use particularly as a blending wine.

The present studies show (table 37) that it does have a high natural acidity

TABLE 37. COMPOSITION OF MUSTS AND WINES OF SUZÃO

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†
				<i>degrees</i>	<i>gm/ 100cc</i>		<i>per cent vol.</i>	<i>gm/ 100cc</i>	<i>gm/ 100gm</i>	<i>gm/ 100cc</i>		
IV: 1946-58, . . . .	10	11	Oct. 5	23.3	0.80	3.48	19.2	0.59	10.6	0.14	661	78.4
V: 1946-58, . . . .	5	5	Aug. 24	22.3	0.84	3.42	18.0	0.60	7.8	0.13	427	77.0

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

even in Region V, and its high color is one of the most attractive features for the producer of red sweet wines. The variety would probably not do well in regions cooler than IV, where the acidity would be excessive. At present it is recommended for further planting in Regions IV and V. Production at Davis is about 6 tons per acre.

*Sylvaner*: This variety has been present in California for many years and was tested by Hilgard and by Amerine and Winkler (1944).

Sylvaner is a good producer. Mature vines on good soils, over a 15-year period, have averaged 5.8 tons per acre at Davis. However, at Oakville the five-year average is only 3.5 tons per acre. This variety ripens rather early and, in years of high humidity, is somewhat subject to bunch rot, which forces an early harvest.

The composition of the wines (table 38) shows that the best balanced musts are those from Regions I and II, where the pH is not excessive and a reasonable amount of total acidity is retained until the fruits have ripened. In regions warmer than II, the pH becomes progressively higher and the adaptability of the fruit for the production of a high quality dry white wine

TABLE 38. COMPOSITION OF MUSTS AND WINES OF SYLVANER

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†
				degrees	gm/ 100cc		per cent vol.	gm/ 100cc	gm/ 100gm	gm/ 100cc		
I:												
1935-41.....	6	12	Oct. 5	23.2	0.63	3.29	12.7	0.47	2.2	0.03	19.7	....
1946-58.....	10	13	Sept. 28	22.6	0.78	3.25	12.7	0.75	2.5	0.02	13.4	76.0
II:												
1935-41.....	6	11	Sept. 28	23.6	0.60	3.39	13.1	0.48	2.5	0.03	11.9	....
1946-58.....	4	7	Sept. 25	21.2	0.73	3.42	12.1	0.67	2.6	0.02	16.7	75.4
III:												
1935-41.....	1	1	Sept. 11	22.6	0.63	3.51	12.3	0.44	2.0	0.03	....	....
1946-58.....	3	3	Sept. 16	22.0	0.73	3.53	12.2	0.65	2.5	0.03	25.0	74.7
IV:												
1935-41.....	7	20	Sept. 6	22.5	0.63	3.51	12.1	0.52	2.5	0.04	17.1	....
1946-58.....	12	17	Sept. 13	22.1	0.74	3.52	12.2	0.65	2.7	0.03	20.5	74.2
V:												
1946-58.....	3	3	Aug. 26	22.9	0.64	3.67	12.7	0.52	2.6	0.02	13.3	73.2

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

is lessened. Somewhat greater differences in composition and acidity are shown in the postwar samples than in those collected before World War II. The aroma of the wines of Sylvaner is not highly distinctive and is easily covered if the wines become at all oxidized. For this reason it is recommended that the must be removed from the skins rapidly and that every attempt be made to prevent oxidation in the handling of the wine. In addition, early bottling seems to be desirable. The best wines of this variety have been of above average quality.

Sylvaner appears to be suited to Region I, but its susceptibility to bunch rot may limit the plantings in that region. In the best exposed conditions, however, some plantings of Sylvaner can probably still be made in Region I. Its best California location is probably in Region II, and we have tasted some good wines made commercially in Region III. We have had extensive experience with this variety in Region IV, where its wines are seldom of more than passing interest because of their relatively low acidity and poor production.

For a recent history and description of Sylvaner see Cosmo and Polsinelli (1959c). They found that, even in northern Italy, with sugars of 15.1 to 21.8 per cent, the pH range of Sylvaner musts was high—3.35 to 3.98 (average, 3.56). However, the wines of these same musts were much lower in pH—2.76 to 3.60 (average, 3.16), indicating a possible error in the must measurements. Also, the minimum alcohol of 10.9 determined by these workers could hardly have been derived from grapes with only 15.1 per cent sugar. In a special note, Cosmo and Polsinelli indicate that the must sample probably came from different parts of the grape than did the wine. This would not be true of white wines fermented solely from the free-run must.



*Teroldico*: This variety has been tested at Davis for a nine-year period, for the production of red sweet wines. It has averaged 5.1 tons per acre. The variety, which ripens rather late, is obviously a dessert wine variety as shown by its sugar, acid, and pH. Its best qualities are its excellent color and the softness of its wines. The variety requires further testing at the University level before any commercial plantings are made. Analytical data are given in table 39. This variety is widely planted in Italy under the name Teroldego (Cosmo and Polsinelli, 1957*c*).

TABLE 39. COMPOSITION OF MUSTS AND WINES OF TEROLDICO

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color inten-sity*	Aver-age score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
IV: 1946-58.....	6	6	Oct. 8	23.8	0.72	3.68	18.7	0.59	11.7	0.14	534	77.7

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.  
† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

*Thompson Seedless*: While this is not a wine grape variety, it is extensively used for that purpose in California and elsewhere. Its composition is therefore indicated for the guidance of those who do use it for winemaking. Amerine and Winkler (1942) and Amerine (1951) indicated that Thompson Seedless is a high tartrate variety and that, as such, its wine should have a relatively stable acidity. Unfortunately, most of the Thompson Seedless grapes in the San Joaquin Valley are picked too late for the making of a well-balanced table wine and, in many cases, for a well-balanced dessert wine.

TABLE 40. COMPOSITION OF MUSTS AND WINES OF THOMPSON SEEDLESS

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color inten-sity*	Aver-age score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
III: 1946-58.....	1	1	Sept. 15	24.0	0.63	3.50	13.9	0.58	2.5	0.02	9.0	75.0
IV: 1935-41.....	2	8	Oct. 13	24.8	0.60	3.60	12.7	0.39	2.5	0.03	....	....
1946-58.....	2	2	Sept. 10	21.1	0.61	....	11.6	0.66	2.0	0.03	11.0	73.5
V: 1946-58.....	3	8	Sept. 5	21.8	0.60	3.48	11.8	0.52	2.2	0.02	5.2	73.1

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.  
† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.



For Regions IV and V, Thompson Seedless should be harvested in early or mid-September if the advantages of its high percentage of tartrate are to be retained.

While there is, therefore, no great objection to Thompson Seedless on the basis of its sugar and acid balance when it is harvested at the proper time, the chief disadvantage of the variety is its very neutral flavor. The variety cannot be used for producing a high-quality table wine although it is acceptable for standard competitive wines. It is much better when converted into sherry or into a flor-yeast type of wine in which the process adds character to its neutral flavor. This neutral flavor also recommends Thompson Seedless as a base for flavored wines, where it will not interfere with any of the added flavors. The Thompson Seedless will undoubtedly continue to be used for these purposes. Analytical data are given in table 40.

*Tinta Cão:* This variety is not highly productive although the vines are quite vigorous—an average of only 3.8 tons per acre over a 14-year period at Davis. Its fruit is small and quite resistant to undesirable climatic conditions, so that it almost always arrives at the crusher in good condition.

In Region V, *Tinta Cão* ripens fairly early, while at Davis it has generally been picked in October. The composition of the fruit (table 41), with moderate acidity and high but not excessively high pH, is quite good for dessert wine production. The chief defect of the variety, of course, is its low color, which frequently results in only pink wines rather than the full red, ruby-colored wines desired by most port-type producers. Consequently, we believe that varieties other than *Tinta Cão* would be more suitable for planting in Regions IV and V for the production of red sweet wines. The plantings already established in those areas will, of course, be utilized for port production, but they will require blending in of wines of higher color. Furthermore, the rather low production of the variety will not recommend it to many of our production-conscious grape growers.

TABLE 41. COMPOSITION OF MUSTS AND WINES OF TINTA CÃO

Region and years	No. of years sam- ples taken	No. of sam- ples	Average date of harvest	Must			Wine						
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†	
				<i>degrees</i>	<i>gm/ 100cc</i>		<i>per cent vol.</i>	<i>gm/ 100cc</i>	<i>gm/ 100gm</i>	<i>gm/ 100cc</i>			
IV:													
1935-41.....	6	13	Oct. 6	23.5	0.62	3.77	18.5	0.37	9.1	0.08	178	....	
1946-58.....	10	23	Oct. 13	22.9	0.73	3.68	18.7	0.47	11.3	0.05	153	74.6	
V:													
1935-41.....	1	1	Aug. 29	22.8	0.63	3.72	20.6	0.41	5.7	0.10	83	....	
1946-58.....	3	3	Sept. 19	21.8	0.62	3.73	20.7	0.38	12.8	0.07	306	75.3	

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

*Tinta Madeira*: This variety has been extensively tested in Regions I, IV, and V. It has proved remarkably well adapted for the production of sweet dessert wines in all three regions, particularly when it was picked late enough in Region I. This is a fairly good producing variety. At Davis, during a 14-year period, it averaged 5.6 tons per acre, with a maximum of 9.2. The five-year average at Oakville was 3.4 tons per acre. However, the variety is rather temperamental in so far as bunch rot is concerned, and some difficulty in producing fruit of high quality has been experienced in local areas in Region V. Even in Region IV, in years of early rainfall, there has been considerable bunch rot in this variety. Surprisingly enough, however, the fruit from Region I, with its smaller berries, has usually arrived at the winery in fairly good condition. In Region V, judicious irrigation has aided in the control of bunch rot.

*Tinta Madeira* has a fairly good balance of sugar and acid (table 42).

TABLE 42. COMPOSITION OF MUSTS AND WINES OF TINTA MADEIRA

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color inten-sity*	Aver-age score†
				<i>degrees</i>	<i>gm/100cc</i>		<i>per cent vol.</i>	<i>gm/100cc</i>	<i>gm/100gm</i>	<i>gm/100cc</i>		
I:												
1946-58.....	7	7	Oct. 8	23.6	0.57	3.47	19.7	0.43	13.1	0.12	379	78.1
IV:												
1935-41.....	6	18	Oct. 6	24.9	0.60	3.71	18.6	0.44	11.9	0.09	188	....
1946-58.....	12	23	Sept. 28	23.9	0.72	3.57	19.4	0.53	12.0	0.09	185	76.7
V:												
1946-58.....	5	11	Aug. 30	22.7	0.74	3.58	19.1	0.54	12.1	0.07	165	76.9

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.  
† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

Furthermore, its wines have a good color in Regions IV and V, and excellent color in Region I. However, the tannin content is relatively low, and this leads to early maturing of red sweet wines with a considerable degree of tartness. The earlier recommendations in favor of *Tinta Madeira* have been borne out in the more recent experiments. Some tasters find it to have a recognizable varietal character, which is, of course, desirable in a high-quality wine. The only drawback to *Tinta Madeira* is the above-mentioned tendency to bunch rot in certain areas, but proper pruning and irrigation will help to control this.

*Touriga*: An important variety in the Douro region of Portugal, *Touriga* has been tried rather extensively in Region IV and to a lesser extent in Region V for the production of red sweet dessert wines. Over an eight-year period at Davis its yield averaged 6.3 tons per acre. The vines are vigorous and the fruit is generally reasonably free of mold rot. The composition of the fruit (table 43) indicates that it ripens in late mid-season, with a fairly good acid-

TABLE 43. COMPOSITION OF MUSTS AND WINES OF TOURIGA

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color inten-sity*	Aver-age score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
IV: 1946-58.....	11	11	Oct. 11	22.7	0.72	3.53	19.3	0.48	12.4	0.11	204	77.5
V: 1946-58.....	2	2	Sept. 11	21.0	0.83	3.55	18.4	0.41	11.6	0.08	146	74.5

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

pH-to-sugar relationship. The wines have above-average color and good tannin content and have aged fairly rapidly into average and above-average quality red sweet wines. This variety is recommended for trial plantings in various areas of Regions IV and V.

*Verdelho*: This variety has been available in California for many years. It was tested (but inadequately) in 1944 (Amerine and Winkler, 1944), and was recommended for high-quality white dessert wine by Amerine (1955).

*Verdelho* is a moderate producer. Over a seven-year period, average production at Davis was 5.9 tons per acre, with a maximum of 9.7. It is a vigorous grower, and the fruit ripens without undue raisining. Another valuable characteristic of the variety is that it matures fairly early in the season and retains a good acidity at the time it reaches a rather high degree of sugar (table 44). The wines have therefore been fruity in character and above aver-

TABLE 44. COMPOSITION OF MUSTS AND WINES OF VERDELHO

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color inten-sity*	Aver-age score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
IV: 1935-41.....	1	1	Sept. 22	29.6	0.63	3.79	20.5	0.43	14.8	0.04	14.0	....
1946-58.....	10	12	Sept. 22	25.2	0.84	3.47	19.2	0.60	13.6	0.03	11.3	77.5

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

age in quality. Small plantings of this variety in the interior valleys would be of interest to winemakers, and if a demand for high-quality white sweet wines developed, this variety would serve the purpose admirably.



*White Riesling*: A superior wine type, this variety has been highly recommended in Germany and Central Europe. It has been favored in California by those wishing to produce wines of this character, and has been planted in the state for a great many years. Cosmo and Polsinelli (1958*b*) have described White Riesling in Italy. Reasons for calling the variety White Riesling, and not Johannesberg (or Johannesberger) Riesling, were given by Amerine (1949).

The variety is a moderate producer. Young vines at Davis had a 14-year average of 4.9 tons per acre, with a maximum of 7.8. Under conditions of wide spacing (6 × 12 and 8 × 12 feet) it has produced 4.1 and 4.4 tons, respectively, at Oakville. The variety is subject to sunburn in California, which has resulted in rather oxidized and dark-colored wines in certain years. For this reason alone, it is likely that the cooler part of Region I will be best for White Riesling.

White Riesling is capable of achieving a fairly high sugar content in Regions I or II while still retaining a rather low pH and moderate acidity. In Regions III and IV, however, the total acidity is low, even when the grapes are picked rather early, and the pH is rather high for the best white table wines. It is of interest to note that Bioletti (1908) recommended White Riesling for Region V. For best results the White Riesling should be grown in the coolest parts of California, fermented at low temperatures, bottled

TABLE 45. COMPOSITION OF MUSTS AND WINES OF WHITE RIESLING

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†
				<i>degrees</i>	<i>gm/ 100cc</i>		<i>per cent vol.</i>	<i>gm/ 100cc</i>	<i>gm/ 100gm</i>	<i>gm/ 100cc</i>		
I: 1946-58.....	11	34	Sept. 20	22.0	0.80	3.21	12.5	0.74	2.7	0.03	8.1	76.0
II: 1935-41.....	3	3	Sept. 13	23.0	0.69	3.15	12.4	0.50	2.2	0.05	12.0	....
1946-58.....	1	1	Sept. 25	19.4	0.83	3.40	10.5	0.74	2.5	0.04	34.0	75.0
III: 1935-41.....	2	2	Sept. 5	24.0	0.64	3.33	12.8	0.64	2.4	0.05	10.0	....
1946-58.....	1	1	Oct. 5	20.4	0.74	3.30	11.1	0.73	2.4	0.05	10.0	77.5
IV: 1935-41.....	7	23	Sept. 17	22.4	0.68	3.43	12.3	0.48	2.3	0.03	18.1	....
1946-58.....	13	29	Sept. 26	22.3	0.73	3.38	12.5	0.64	2.8	0.03	11.1	75.6

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

rather young, and kept as fresh and fruity as possible. At its best in California it is a high-quality variety, but we must confess that not all of the White Riesling produced here or commercially has reached this high standard. Analytical data are given in table 45.

*Xeres*: This variety has been tested for red dessert wines for eight years. It ripens late at Davis and achieves a moderate degree of sugar with a not too unfavorable sugar-acid balance. The production is low. The wines have been of good quality with a moderate ruby-red color (table 46). At this time we cannot eliminate *Xeres* as a variety that would produce red dessert wines of above-standard quality, but it does not appear to be sufficiently outstanding in production or quality to merit more than further testing by the University.

TABLE 46. COMPOSITION OF MUSTS AND WINES OF XERES

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color inten-sity*	Aver-age score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
IV: 1946-58.....	8	8	Oct. 15	22.3	0.72	3.46	19.0	0.46	12.4	0.06	134	75.9

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.  
† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

*Zinfandel*: This famous variety has been tested in all parts of California. It ripens unevenly, and at Davis ripening has proved difficult because of over-cropping. *Zinfandel* has a good sugar-acid balance in the cooler locations of the state. It shows a tendency to develop bunch rot in the interior valleys;

TABLE 47. COMPOSITION OF MUSTS AND WINES OF ZINFANDEL

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color inten-sity*	Aver-age score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
I:												
1935-41.....	7	21	Oct. 8	23.2	0.83	3.31	12.7	0.69	2.9	0.14	264	....
1946-58.....	8	17	Oct. 15	21.3	0.94	3.16	12.1	0.89	3.1	0.12	271	75.8
II:												
1935-41.....	7	27	Sept. 29	24.0	0.71	3.41	13.5	0.61	2.9	0.13	243	....
1946-58.....	4	6	Oct. 5	22.4	0.92	3.25	11.9	0.79	3.3	0.16	328	74.9
III:												
1935-41.....	7	18	Sept. 23	23.8	0.64	3.42	12.4	0.51	2.8	0.13	210	....
1946-58.....	4	8	Sept. 24	22.2	0.85	3.34	12.3	0.80	3.1	0.15	238	74.6
IV:												
1935-41.....	7	28	Sept. 14	23.0	0.70	3.50	12.2	0.48	2.9	0.10	193	....
1946-58.....	8	30	Oct. 2	21.6	0.77	3.44	11.5	0.70	3.0	0.11	166	73.6
V:												
1935-41.....	4	14	Aug. 29	24.0	0.53	3.78	12.6	0.48	3.2	0.17	241	....
1946-58.....	3	3	Sept. 1	22.0	0.71	3.40	11.7	0.59	2.5	0.09	110	75.5

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.  
† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

therefore, only well-drained, dry locations are suitable for plantings. Judicious control of irrigation may aid in bunch rot control. The variety is also subject to red spider, which suggests caution on the part of prospective planters.

Production at Oakville averaged 4.1 tons per acre, with a maximum of 5.3, over a six-year period. Analytical data are given in table 47.

Contrary to the opinion of many, the wines of Zinfandel do mature and can be aged for a number of years in cask and in bottle with satisfactory results. They should never be blended. (Overcropping should be avoided if wines of distinctive flavor are to be produced.)

For further information on Zinfandel, see Olmo and Amerine (1938) and Amerine and Winkler (1944); for data on handling of Zinfandel grapes and wines, see Amerine (1949).

## NONRECOMMENDED VARIETIES

*Cabernet franc*: This variety originated in the Bordeaux region of France, where it is a minor variety in the Médoc area and a major variety in St. Émilion. It has been grown in California in Cabernet Sauvignon vineyards for many years. It resembles the Cabernet Sauvignon vegetatively in many respects. It is particularly similar in flavor, but is believed to be heavier in production, and have larger berries, and less color and tannin. Thus it produces a wine which ages more rapidly than the Cabernet Sauvignon. At Davis it has produced only slightly more than Cabernet Sauvignon, while at Oakville it averaged 4.9 tons per acre.

Good recent descriptions of Cabernet franc are given by Cosmo and Polsinelli (1957*a*). They recognized it as a high-quality variety which aged well. In the localities in which they tested it in northern Italy it was quite variable in sugar and acidity—much more so than we have noted here.

The present report summarizes the most extensive tests made on this

TABLE 48. COMPOSITION OF MUSTS AND WINES OF CABERNET FRANC

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†
				degrees	gm/ 100cc		per cent vol.	gm/ 100cc	gm/ 100gm	gm/ 100cc		
I: 1946-58.....	6	6	Oct. 5	22.9	0.63	3.30	12.1	0.71	2.9	0.14	351	77.0
II: 1946-58.....	2	2	Oct. 10	20.1	0.72	3.25	9.7	0.76	2.8	0.16	220	75.7
IV: 1946-58.....	10	14	Sept. 29	23.8	0.64	3.57	12.0	0.49	3.1	0.10	164	73.8

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.



variety in California (table 48). In the cooler regions it has produced wines of high quality rather regularly. As predicted, they were not of high color, and they do appear to age rapidly. In the warmer regions few wines of high quality were produced and these often deteriorated in quality during aging—usually as a result of excessive malo-lactic fermentation.

While it produces wines with a characteristic Cabernet aroma, Cabernet franc cannot be recommended for California conditions. This finding agrees with that of Goncharenko (1955).

*Ezerjo*: This variety is much appreciated in Hungary, where it originated. Our studies at Davis and Oakville have not shown it to have any very interesting characteristics. It produces only moderate crops—4.8 tons per acre at Oakville. Furthermore, it ripens late and produces sound but undistinguished wines. We see no place for it in the California wine industry. The analytical data are given in table 49.

TABLE 49. COMPOSITION OF MUSTS AND WINES OF EZERJO

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color inten-sity*	Aver-age score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
I: 1953.....	1	1	Oct. 5	22.1	0.74	3.30	12.0	0.89	2.7	0.05	10	71.5
IV: 1938-41.....	4	4	Sept. 20	21.8	0.61	3.38	12.4	0.47	2.4	0.05	22	.....
1948-54.....	3	3	Sept. 25	21.3	0.68	3.37	11.0	0.73	3.9	0.04	12	75.2

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

*Gamay de Burgoyne*: This variety resembles Pinot noir much less than does Gamay Beaujolais. Its wines have not been impressive. In Region I they are fruity, but with little distinction, and in IV the acidity and color are low and

TABLE 50. COMPOSITION OF MUSTS AND WINES OF GAMAY DE BURGOYNE

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color inten-sity*	Aver-age score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
I: 1946-58.....	2	3	Oct. 1	23.8	0.86	3.27	11.7	0.87	3.1	0.04	74	76.0
IV: 1946-58.....	12	17	Sept. 11	22.4	0.94	3.36	11.1	0.65	2.6	0.07	135	72.8

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

the pH too high. Its production over a 12-year period at Davis has averaged slightly over 6 tons per acre, with a maximum of 10.5. At Oakville it has averaged 4.3 tons per acre over a five-year period, with a maximum of 8.2. The variety cannot be recommended for planting. Analytical data are given in table 50.

*Gamay Teinturier*: This red-juiced variety has been tested both for a red wine and a rosé—with equal lack of success. In only one case has it produced a wine of above-average quality. In several years the variety has failed to ripen. Since production is low—below 3 tons per acre at Davis—and the quality only moderate, the variety should not be planted. Analyses are given in table 51.

TABLE 51. COMPOSITION OF MUSTS AND WINES OF GAMAY TEINTURIER

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color inten-sity*	Aver-age score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
II: 1946-58.....	1	1	Sept. 15	20.3	0.92	3.50	10.2	0.53	2.9	0.04	42	74.0
IV: 1946-58.....	9	10	Sept. 12	21.2	0.93	3.37	10.6	0.61	2.9	0.07	105	73.5

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

*Green Veltliner*: This variety has given good standard musts and wines at Oakville. At Davis it is only fair in quality. Since it is a very moderate producer it cannot be recommended for planting. At Davis, maximum production was only 4.9 tons per acre; at Oakville the four-year average was 3.7. Analytical data appear in table 52.

TABLE 52. COMPOSITION OF MUSTS AND WINES OF GREEN VELTLINER

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color inten-sity*	Aver-age score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
I: 1946-58.....	5	5	Sept. 19	23.0	0.67	3.32	13.5	0.75	2.6	0.02	10.8	75.9
IV: 1946-58.....	5	5	Sept. 12	23.1	0.68	3.46	12.9	0.65	2.5	0.02	24.4	73.7

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

*Grignolino*: This variety has enjoyed a good reputation in California, but our pre- and postwar tests have not, with rare exceptions, supported this viewpoint. The reasons for this are not clear. Possibly the commercial wines have been good examples of blending—apparently also true of imported Grignolinos, which rarely have the true Grignolino color. Identification of the variety in some vineyards in this state is also a problem. Some mixed plantings of this variety are apparently not uncommon in Italy. The most recent description of Italian Grignolino is given in Dalmasso, Dell’Olio, and Malfatto (1959*c*), who noted the distinctly tannic taste of the wine. Commercial imported Grignolino wines, however, seldom have this.

The variety has good must acidity but very poor color. The fruit, even from Region II, is only pink, while the wine color has varied from a light pink to an orange-red. The wine is subject to a malo-lactic fermentation so that well-balanced musts have yielded flat and uninteresting wines in some cases. Finally, it is a variety of considerable tannin content, so that, although lacking in color, the wines are likely to be rather astringent. At Davis the average yield for a 14-year period has been 6.3 tons per acre, with a maximum of 10.2.

In view of these findings, further plantings of the Grignolino are not recommended. Analytical data are summarized in table 53.

TABLE 53. COMPOSITION OF MUSTS AND WINES OF GRIGNOLINO

Region and years	No. of years samples taken	No. of sam- ples	Average date of harvest	Must			Wine						
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†	
				<i>degrees</i>	<i>gm/ 100cc</i>		<i>per cent vol.</i>	<i>gm/ 100cc</i>	<i>gm/ 100gm</i>	<i>gm/ 100cc</i>			
I:													
1946-58.....	1	1	Oct. 5	20.6	1.00	3.10	11.3	0.62	2.3	0.10	23	75.5	
IV:													
1936-41.....	6	11	Sept. 11	23.0	0.82	3.35	11.4	0.51	2.8	0.14	67	....	
1946-58.....	11	12	Sept. 24	22.4	1.02	3.27	11.2	0.69	3.2	0.12	76	72.4	
V:													
1936-41.....	6	7	Aug. 28	23.8	0.59	3.63	12.2	0.54	3.0	0.21	44	....	
1946-58.....	5	5	Sept. 3	21.5	0.88	3.30	11.2	0.75	3.0	0.11	66	75.2	

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

*Limburger*: This German variety has been tested by several investigators in California. Its wines are spicy but often unbalanced in acidity. Not one exceptional wine has been produced at Oakville (table 54). Its major defect is extremely variable and low production. At Oakville, under very favorable conditions, it averaged only 2.1 tons per acre. No plantings are recommended, nor is further testing required.



TABLE 54. COMPOSITION OF MUSTS AND WINES OF LIMBURGER

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†
				degrees	gm/ 100cc		per cent vol.	gm/ 100cc	gm/ 100gm	gm/ 100cc		
I:												
1936-39.....	3	3	Sept. 26	22.8	0.73	3.19	12.3	0.62	2.7	0.16	554	....
1955-58.....	3	3	Sept. 12	22.4	0.98	3.23	11.9	0.89	3.2	0.18	508	74.2
IV:												
1935-40.....	6	7	Sept. 5	23.4	0.78	3.42	11.1	0.55	2.9	0.16	281	....
1948-50.....	3	3	Sept. 5	21.2	0.91	3.47	9.7	0.53	3.4	0.11	172	72.3

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

*Malbec*: It is hard to believe that this is the same variety that is so popular in the Bordeaux region of France and in Argentina. But the characteristics which recommend it in France make it a very poor grape for Region IV and of doubtful utility for the cooler regions. In Bordeaux the Malbec is valued for its relatively high pH and high malic acid content. (For a detailed description see Amerine, 1956.)

In Region IV its musts have been high in pH. The wines have frequently undergone a malo-lactic fermentation so that their pH has been very high, their taste exceedingly flat, and the quality low. In Region I, conditions are not so exaggerated, but a must pH of 3.47 and a wine pH of 3.60 are too high and, with two or three exceptions, the wine quality has not been notable. Fermenting with another variety might give better results, and this possibility is being investigated. Malbec has a slight Cabernet-like aroma which should make it useful in such blends. Analytical data are given in table 55.

TABLE 55. COMPOSITION OF MUSTS AND WINES OF MALBEC

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†
				degrees	gm/ 100cc		per cent vol.	gm/ 100cc	gm/ 100gm	gm/ 100cc		
I:												
1946-58.....	8	9	Sept. 25	22.0	0.88	3.40	11.0	0.67	3.0	0.15	475	74.6
II:												
1935-41.....	2	2	Oct. 10	20.6	0.71	3.07	11.5	0.75	2.6	0.17	387	....
IV:												
1935-41.....	7	19	Sept. 15	23.7	0.71	3.65	11.7	0.46	2.9	0.13	262	....
1946-58.....	12	15	Sept. 20	22.8	0.85	3.60	11.1	0.56	3.3	0.13	240	73.9

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

Production is moderate and irregular. At Oakville over a three-year period it averaged 5.3 tons per acre, with a maximum of 8.7. At Davis the yield has averaged only 5.8 tons. Selected clones might improve these yields. We cannot recommend this variety for planting.

**Marsanne:** This heavy-producing variety originated in southeastern France. It has been tested only in Region IV, where it has never produced a high-quality wine. However, its wines have been of average quality, and the fruit arrives in good condition at the crusher. It is possible that Marsanne should be tested in an area cooler than Region IV since it is of low acidity and moderately high pH. Marsanne is not recommended for planting in California at present. Analytical data are given in table 56.

**Mataro:** This variety has been tested in many parts of California by several investigators. Its deficiencies are now well known—lack of color and rather

TABLE 56. COMPOSITION OF MUSTS AND WINES OF MARSANNE

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color inten-sity*	Aver-age score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
IV:												
1935-41.....	4	7	Sept. 20	22.7	0.55	3.54	12.7	0.43	2.4	0.05	22.0	....
1946-58.....	4	6	Sept. 23	22.4	0.60	3.44	12.9	0.55	2.4	0.02	17.0	73.2

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

TABLE 57. COMPOSITION OF MUSTS AND WINES OF MATARO

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color inten-sity*	Aver-age score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
I:												
1935-41.....	7	16	Oct. 10	20.7	0.93	3.23	11.1	0.66	2.6	0.13	258	....
II:												
1935-41.....	7	16	Sept. 29	21.3	0.69	3.33	11.1	0.57	2.4	0.08	158	....
1946-58.....	2	2	Oct. 5	19.3	0.89	3.35	9.5	0.68	2.6	0.06	151	74.0
III:												
1935-41.....	2	4	Oct. 7	20.1	0.63	3.42	10.8	0.50	2.3	0.06	133	....
IV:												
1935-41.....	3	6	Sept. 21	23.3	0.47	3.67	12.4	0.38	2.7	0.08	164	....
V:												
1935-41.....	1	1	Sept. 11	22.4	0.45	....	11.4	0.41	2.5	0.06	....	....

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

neutral flavor. Its only merit appears to be that it is less subject to mildew than is Carignane. It has been less productive than Carignane—average, about 7 tons per acre. Mataro is not recommended for planting in California, and no further trials are contemplated. Analytical data are given in table 57.

*Mathiasz y-ne:* Tests with this Hungarian variety, both before and after World War II, have not shown very interesting results. It is not a high producer (4 to 7.5 tons per acre at Davis). Furthermore, its fruit tends to raisin on the vine, and it has a considerable second crop. The musts are too low in acidity and much too high in pH; and the wines have a distinct raisin flavor without being very distinctive in muscat character. It is unlikely that this variety would do any better in a cooler region, and it certainly would be poor in a warmer region. It is not recommended for further trial in the state. Analytical data are given in table 58.

TABLE 58. COMPOSITION OF MUSTS AND WINES OF MATHIASZ Y-NE

Region and years	No. of years sam- ples taken	No. of sam- ples	Average date of harvest	Must			Wine					
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†
				degrees	gm/ 100cc		per cent vol.	gm/ 100cc	gm/ 100gm	gm/ 100cc		
IV:												
1935-41.....	4	4	Sept. 26	25.3	0.46	3.95	19.8	0.29	13.9	0.06	44.6	....
1946-58.....	3	3	Sept. 24	22.6	0.42	3.80	20.0	0.30	11.8	0.03	26.0	74.8

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

*Meunier:* This Pinot-type variety has been tested in California many times during the past 80 years. It has never produced as high quality a wine as that of its relative, the Pinot noir. The general reputation of the variety abroad is

TABLE 59. COMPOSITION OF MUSTS AND WINES OF MEUNIER

Region and years	No. of years sam- ples taken	No. of sam- ples	Average date of harvest	Must			Wine					
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†
				degrees	gm/ 100cc		per cent vol.	gm/ 100cc	gm/ 100gm	gm/ 100cc		
I:												
1935-41.....	1	1	Oct. 16	18.5	0.60	....	9.1	0.43	2.3	0.09	....	....
1946-58.....	5	5	Sept. 15	22.7	0.84	3.32	12.2	0.74	3.0	0.11	102	76.6
IV:												
1935-41.....	4	6	Aug. 21	22.2	0.67	3.41	11.4	0.42	2.6	0.11	57.8	....
1946-58.....	5	7	Sept. 4	22.1	0.68	3.43	11.0	0.52	2.9	0.09	119	73.4

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.



that it is less suitable for making high-quality wines than is Pinot noir. It is a small producer—3.9 tons per acre over a three-year period at Oakville. Certainly this would be a big handicap for any future plantings in the state. The analytical data in table 59 indicate that in Region I it has moderately well-balanced musts, but that its wines are very low in color. For these reasons no further trials or plantings are recommended for this state.

*Mortagua*: This Portuguese variety has been tested in Region IV both as a dry red wine and as a red sweet dessert wine. It is ill adapted to the former because of the high pH of its must, and it has made only average-quality dessert wines. However, these have had a distinct dessert wine character and it is probable that Mortagua should be considered as a dessert wine variety. The production is only moderate—4.4 to 6.2 tons per acre at Davis. The variety is not recommended for planting at present. Analytical data are given in table 60.

TABLE 60. COMPOSITION OF MUSTS AND WINES OF MORTAGUA

Region and years	No. of years sam- ples taken	No. of sam- ples	Average date of harvest	Must			Wine					
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†
IV:				<i>degrees</i>	<i>gm/ 100cc</i>		<i>per cent vol.</i>	<i>gm/ 100cc</i>	<i>gm/ 100gm</i>	<i>gm/ 100cc</i>		
1946-58.....	4	4‡	Oct. 22	22.2	0.68	3.65	11.3	0.51	3.1	0.07	129	71.4
1946-58.....	4	4§	Oct. 20	23.7	0.60	3.58	19.7	0.44	11.8	0.10	167	75.1

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

‡ Red dry.

§ Red sweet.

*Müller-Thurgau*: This German variety has not previously been tested in California although it is well known in Germany and Switzerland. It is an early-ripening variety with a slight muscat-type aroma. A low producer, it

TABLE 61. COMPOSITION OF MUSTS AND WINES OF MÜLLER-THURGAU

Region and years	No. of years sam- ples taken	No. of sam- ples	Average date of harvest	Must			Wine					
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†
I:				<i>degrees</i>	<i>gm/ 100cc</i>		<i>per cent vol.</i>	<i>gm/ 100cc</i>	<i>gm/ 100gm</i>	<i>gm/ 100cc</i>		
1946-58.....	3	3	Sept. 22	22.0	0.65	3.50	13.3	0.48	2.4	0.03	14.0	73.3
IV:												
1946-58.....	4	4	Sept. 17	22.1	0.63	3.40	12.1	0.56	2.5	0.02	12.5	76.1

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

averaged 3.9 tons (maximum, 6.75) at Davis and 3.1 (maximum, 5.3) at Oakville. The musts from Region I were not so well balanced as those from Region IV (table 61), probably because of their rather high alcohol content. In 1956, in Germany, the variety was found to be susceptible to winter killing, but this problem is not likely to be of importance in California. Because of its early ripening, the Müller-Thurgau variety might find a limited place in regions where other early-ripening grapes will not mature. From the results obtained thus far, however, it is not recommended for planting in California.

*Muscat Hamburg:* This variety has a unique, exceedingly pleasant aroma which has led to our extensive investigations of its possible use for a specific type of red, muscat-flavored dessert wine. The variety is a fair producer (6 to 7 tons per acre at Davis), and can be used as a table grape as well as a wine grape. At Oakville, over a four-year period, the yield has averaged only 2.5 tons per acre. The musts have a satisfactory balance for a dessert wine, but the wines have been of only average quality, probably because of the low

TABLE 62. COMPOSITION OF MUSTS AND WINES OF MUSCAT HAMBURG

Region and years	No. of years sam- ples taken	No. of sam- ples	Average date of harvest	Must			Wine					
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†
				degrees	gm/ 100cc		per cent vol.	gm/ 100cc	gm/ 100gm	gm/ 100cc		
Red sweet												
I: 1935-41.....	2	2	Oct. 7	23.6	0.48	3.61	17.0	0.33	12.0	0.12	195	....
III: 1935-41.....	1	1	Sept. 8	23.9	0.45	4.01	20.1	0.26	10.3	0.05	102	....
IV: 1935-41.....	6	12	Oct. 2	24.5	0.49	3.64	19.1	0.40	11.2	0.08	161	....
1946-58.....	8	9	Oct. 9	24.8	0.60	3.64	18.8	0.44	11.9	0.08	86.5	76.4
V: 1935-41.....	4	5	Aug. 31	23.4	0.44	3.58	18.3	0.31	9.8	0.06	64	....
Dry red												
I: 1935-41.....	5	5	Oct. 17	22.5	0.86	3.31	12.2	0.66	2.8	0.17	152	....
III: 1935-41.....	1	1	Oct. 10	22.0	0.48	....	11.2	0.38	2.5	0.13	....	....
IV: 1935-41.....	1	3	Oct. 8	23.7	0.51	....	12.3	0.41	2.2	0.10	....	....
1946-58.....	2	2	Oct. 30	21.4	0.69	3.55	11.0	0.38	2.6	6.07	60	68.3
V: 1935-41.....	2	4	Sept. 2	23.5	0.54	3.97	11.4	0.37	2.6	0.13	48	....

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

color—rather amber—which gives them an unpleasant appearance, thereby lowering their scores. The flavor is very distinctive, and different from that of the other muscat-flavored varieties. Muscat Hamburg has also been tried as a red, muscat-flavored table wine (table 62). In most cases it has not been sufficiently well balanced for even a muscat-flavored red sparkling wine. The Muscat Hamburg is not recommended for planting as a wine grape in California, primarily because of its lack of color. However, this deficiency might be partially overcome by blending.

*Muscat Saint Laurent:* This variety is unlikely to find a place in the California industry, not only because of poor must composition (table 63), but also because of poor production—3.8 tons per acre average at Davis. Furthermore, it does not produce the strong-flavored muscat wines essential for success in the California industry. The variety cannot be recommended for further trial nor for planting in California.

*Muscat Terracina:* This variety resembles a table grape more than a wine grape. In some years it has been difficult to produce a crop with high enough

TABLE 63. COMPOSITION OF MUSTS AND WINES OF MUSCAT SAINT LAURENT

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Balling	Total acid	pH	Alcohol	Fixed acid	Extract	Tannin	Color intensity*	Average score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
IV:												
1935-41.....	4	4	Sept. 27	26.8	0.40	3.78	19.8	0.30	13.3	0.05	33	....
1946-58.....	1	1	Sept. 15	23.9	0.42	3.80	20.7	0.32	5.8	0.03	21	73.5

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.  
† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

TABLE 64. COMPOSITION OF MUSTS AND WINES OF MUSCAT TERRACINA

Region and years	No. of years sam- ples taken	No. of sam- ples	Average date of harvest	Must			Wine					
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†
				<i>degrees</i>	<i>gm/ 100cc</i>		<i>per cent vol.</i>	<i>gm/ 100cc</i>	<i>gm/ 100gm</i>	<i>gm/ 100cc</i>		
White sweet												
IV:												
1935-41.....	3	3	Oct. 5	22.0	0.49	3.70	20.7	0.30	8.7	0.03	33	....
1946-58.....	1	1	Oct. 25	18.2	0.53	3.60	17.6	0.27	12.5	0.01	5	71.5
V:												
1935-41.....	1	1	Aug. 21	20.7	0.49	3.57	19.0	0.34	12.8	0.05	52	....
1946-58.....	1	1	Sept. 5	19.9	0.63	3.30	16.2	0.33	13.3	0.01	14	72.5

table continued



TABLE 64 (CONTINUED). COMPOSITION OF MUSTS AND WINES OF MUSCAT TERRACINA

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color inten-sity*	Aver-age score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
Dry white												
IV: 1935-41.....	2	2	Oct. 19	18.9	0.45	3.58	10.4	0.37	2.1	0.04	14	....

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

sugar for the production of dessert wines. In no instance have the wines been of high quality. Furthermore, the pulpy nature of the fruit results in a poor juice yield. This, together with a lack of muscat aroma, makes it unlikely that further trials are needed in this state. Available analyses for the experiments in California are given in table 64.

*Nebbiola*: This complex of varieties has not been completely straightened out, and it is probable that at least three (and possibly more) different strains have been collected in our tests.

For a long description of the *Nebbiola* family, see Dalmasso *et al.* (1959). These writers use a notably large number of synonyms to describe the four different strains.

The *Nebbiola fino* type seems rather high in total acid and the *Nebbiola Tronero* type is somewhat lower in total acidity and higher in pH. We have

TABLE 65. COMPOSITION OF MUSTS AND WINES OF NEBBIOLA, NEBBIOLA FINO, AND NEBBIOLA TRONERO

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color inten-sity*	Aver-age score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
Nebbiola												
IV: 1935-41.....	7	16	Sept. 23	22.3	0.79	3.31	11.2	0.59	2.8	0.14	164	....
1946-58.....	3	4	Sept. 20	21.3	0.84	3.18	10.7	0.78	3.0	0.13	327	73.9
V: 1935-41.....	3	3	Aug. 27	22.1	0.64	3.56	10.7	0.51	2.7	0.14	88	....

table continued

TABLE 65 (CONTINUED). COMPOSITION OF MUSTS AND WINES OF NEBBIOLA,  
NEBBIOLA FINO, AND NEBBIOLA TRONERO

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†
				degrees	gm/ 100cc		per cent vol.	gm/ 100cc	gm/ 100gm	gm/ 100cc		
Nebbiola fino												
IV:												
1946-58....	2	2	Oct. 5	21.4	1.04	3.25	10.1	0.67	3.0	0.10	63.5	72.7
Nebbiola Tronero												
IV:												
1946-58....	2	2	Sept. 30	25.5	0.79	3.50	12.9	0.79	3.2	0.20	678	75.5

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

made both rosé and dry red wines from their fruit. Because they are generally lacking in color, they are not all-purpose red wine varieties under conditions of Regions IV or V. They are good producers, with average yields of about 6 tons per acre at Davis, and a maximum of over 9. Analytical data are given in table 65. Unless a superior strain with adequate color is located, further testing in Regions IV and V appears unnecessary.

*Negrara Gattinara:* This Italian variety has been extensively tested both before and after World War II, but the wines have been disappointing. It probably would not ripen satisfactorily in conditions much cooler than those of Davis, and it is already rather high in pH under Region IV conditions. Thus there does not seem to be much place for it in the industry. However,

TABLE 66. COMPOSITION OF MUSTS AND WINES OF NEGRARA GATTINARA

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†
				degrees	gm/ 100cc		per cent vol.	gm/ 100cc	gm/ 100gm	gm/ 100cc		
IV:												
1935-41....	7	11	Sept. 16	20.8	0.72	3.49	10.6	0.46	2.9	0.14	242	....
1946-58....	5	5	Sept. 21	22.5	0.72	3.48	11.1	0.55	3.0	0.12	197	73.2

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

it is a good producer—6 tons per acre average at Davis, with a maximum of 10.7. It is unfortunate that further testing cannot be recommended. Analytical data are given in table 66.

*Neiretta*: This is another Italian variety for which we have not found a suitable site in California. The data (table 67) indicate, however, that it is unlikely that a high-quality wine can be produced from this variety. It lacks a distinctive flavor and its musts, from Region IV, are not well balanced for table wines.

TABLE 67. COMPOSITION OF MUSTS AND WINES OF NEIRETTA

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color inten-sity*	Aver-age score†
				<i>degrees</i>	<i>gm/100cc</i>		<i>per cent vol.</i>	<i>gm/100cc</i>	<i>gm/100gm</i>	<i>gm/100cc</i>		
IV:												
1935-41.....	6	6	Sept. 27	23.1	0.63	3.71	11.4	0.46	2.8	0.15	239	....
1946-58.....	2	2	Sept. 30	19.6	0.74	3.55	9.5	0.59	2.7	0.11	151	72.5

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

*Nicholas Horthy*: This Hungarian variety ripens well at Davis, but its wines tend to have a raisined flavor and to be very high in pH and low in acidity (table 68). Furthermore, it is a poor producer (average at Davis, only 3 tons per acre). Its wines are not of high quality. We see no need for further testing of this variety under California conditions.

TABLE 68. COMPOSITION OF MUSTS AND WINES OF NICOLAS HORTHY

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color inten-sity*	Aver-age score†
				<i>degrees</i>	<i>gm/100cc</i>		<i>per cent vol.</i>	<i>gm/100cc</i>	<i>gm/100gm</i>	<i>gm/100cc</i>		
IV:												
1935-41.....	4	4	Sept. 26	26.7	0.54	4.07	20.5	0.34	12.6	0.08	45.5	....
1946-58.....	4	4	Sept. 20	24.2	0.44	3.98	19.4	0.31	12.2	0.04	21.2	75.4

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

*Orleans (Riesling)*: This variety is of practically no value for planting under conditions of Region IV, and its must analysis indicates that it would not be of any interest for the cooler regions. It is a late ripener and does not



TABLE 69. COMPOSITION OF MUSTS AND WINES OF ORLEANS (RIESLING)

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†
				degrees	gm/ 100cc		per cent vol.	gm/ 100cc	gm/ 100gm	gm/ 100cc		
IV:												
1935-41.....	4	4	Sept. 15	23.1	0.62	3.40	12.7	0.52	2.3	0.03	24.5	....
1946-58.....	1	1	Oct. 5	19.9	0.68	3.40	11.0	0.70	2.3	0.01	12.0	70.5

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

always achieve a sufficiently high sugar for a balanced wine. Production is fair—average, 5 tons per acre at Davis, with a maximum of 8.5. Its wines are of very ordinary quality and composition (table 69). No further trials of this variety are indicated.

*Pagadebito*: This variety has been extensively tested in Regions IV and V, and only once in Region I. In Regions IV and V, it is too low in acidity and too high in pH to make a good quality red table wine. The variety is a good producer—6 tons per acre average at Davis, with a 10.5 maximum. The composition and quality of its must and wines are quite ordinary (table 70).

TABLE 70. COMPOSITION OF MUSTS AND WINES OF PAGADEBITO

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†
				degrees	gm/ 100cc		per cent vol.	gm/ 100cc	gm/ 100gm	gm/ 100cc		
I:												
1935-41.....	1	1	Oct. 16	21.6	0.58	....	11.0	0.54	2.5	0.24	....	....
IV:												
1935-41.....	5	7	Sept. 24	21.2	0.46	3.85	10.8	0.42	2.9	0.16	473	....
1946-58.....	1	1	Sept. 25	22.3	0.62	3.70	10.5	0.44	3.3	0.16	263	70.5
V:												
1935-41.....	3	4	Sept. 5	20.1	0.48	3.81	9.3	0.38	2.9	0.21	200	....

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

This variety is not recommended for planting at the present time. For a recent description of *Pagadebito*, see Del Gaudio and Giusto (1956), who consider it a vigorous and productive variety but capable of producing only ordinary wine. Our data confirm this conclusion.

*Palomino*: One of the most widely distributed wine grape varieties in California, *Palomino* is called *Golden Chasselas* in the Napa Valley. Exten-

sive new plantings have been made in recent years in Regions IV and V to provide grapes for use as a base for sherry. Palomino is an excellent producer (7.4 tons per acre average at Davis, with a 13.6 maximum) especially when properly pruned and handled. As a matter of fact, one of the problems with this variety is to prevent overproduction, which keeps the grapes from ripening properly. When this occurs, the already too-low acidity becomes a distinct liability. Table 71 summarizes analyses of Palomino used for a dry white wine and for sherry. It is apparent that the very low total acidity makes the variety undesirable for a dry white wine. In fact, Palomino is usually sold at the lowest price of any of our white wine grape varieties in the table wine regions of the state. It is a liability in Regions I to III. As a sherry material, however, the variety has made a place for itself in the state, and probably will continue to retain this position for some time. Its tendency

TABLE 71. COMPOSITION OF MUSTS AND WINES OF PALOMINO

Region and years	No. of years sam- ples taken	No. of sam- ples	Average date of harvest	Must			Wine					
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†
				degrees	gm/ 100cc		per cent vol.	gm/ 100cc	gm/ 100gm	gm/ 100cc		
Dry white												
I: 1935-41.....	5	6	Oct. 6	21.8	0.37	3.40	12.0	0.43	2.3	0.04	17.3	....
II: 1935-41.....	4	21	Oct. 2	22.2	0.38	3.66	11.9	0.36	2.2	0.03	24.0	....
1946-58.....	1	1	Oct. 5	21.8	0.46	3.60	12.0	0.50	2.6	0.02	12.0	73.5
III: 1935-41.....	5	10	Sept. 29	23.0	0.43	3.52	12.3	0.42	2.3	0.04	44.0	....
1946-58.....	1	1	Sept. 15	20.5	0.57	3.30	11.6	0.60	2.7	0.02	7.0	75.5
IV: 1935-41.....	5	21	Sept. 26	22.9	0.35	3.83	11.9	0.32	2.3	0.04	46.6	....
1946-58.....	9	24	Oct. 5	23.0	0.46	3.77	14.2	0.48	2.6	0.05	24.8	73.3
V: 1935-41.....	3	9	Aug. 17	21.5	0.42	3.88	11.1	0.31	2.2	0.05	....	....
1946-58.....	1	3	Sept. 28	19.9	0.38	3.80	11.4	0.40	....	....	....	70.8
Sherry material												
I: 1935-41.....	1	2	Oct. 18	20.9	0.39	3.51	16.0	0.38	2.5	0.04	43	....
III: 1935-41.....	1	1	Sept. 25	22.6	0.37	3.58	19.6	0.39	6.1	0.02	27	....
IV: 1935-41.....	3	6	Oct. 4	23.5	0.39	3.76	19.8	0.30	6.0	0.08	39	....
1946-58.....	4	6	Oct. 7	21.0	0.46	3.70	19.2	0.38	3.9	0.02	17.2	74.9
V: 1935-41.....	2	3	Aug. 29	23.4	0.32	3.93	19.6	0.37	3.5	0.04	15	....
1946-58.....	1	1	Sept. 5	21.2	0.40	4.00	22.8	0.24	7.1	0.01	22	77.5

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

to oxidize is not a disadvantage for sherry making, since darkening is one of the characteristics of the California process of producing sherry by baking. However, Amerine (1951*b*) has suggested that Palomino is too low in total acidity and too high in pH for the best quality sherry material. A variety of higher acidity and higher sugar would have been a better choice as a basis for our baked California sherry. In spite of the fact that Palomino produces rather flat wines, they seem to be well adapted to our baking process and to result in a high-quality product, particularly when properly aged.

Further plantings of Palomino probably should not be made, and grapes from present plantings in Regions IV and V should be used only for sherry production, never for white table wines. Meanwhile, it is hoped that a variety with higher acid and higher sugar content than Palomino may be developed to take its place. Possibly freeing this variety of virus will result in earlier maturing with a higher acid content.

*Parreira*: This variety has been tested in Region IV for both red table wine and red sweet wine (table 72). It is rather high in pH for a satisfactory

TABLE 72. COMPOSITION OF MUSTS AND WINES OF PARREIRA

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†
				degrees	gm/ 100cc		per cent vol.	gm/ 100cc	gm/ 100gm	gm/ 100cc		
IV:												
1946-58.....	2	2§	Oct. 25	23.5	0.73	3.60	12.5	0.48	3.3	0.08	67	72.3
1946-58.....	4	4	Oct. 25	23.8	0.67	3.65	18.9	0.46	13.0	0.08	112	76.6

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

§ Red dry.  
|| Red sweet.

red table wine. It might do better in Regions II or III, but even there, its very low color is likely to be a disadvantage in so far as the production of a red table wine is concerned. It has produced red dessert wines of moderate quality, but nothing exceptional as yet. It is a good producer—about 6 tons per acre. Because of very late ripening, *Parreira* is subject to rain damage. However, the clusters are very loose and the berries very firm; hence a moderate amount of rain is not likely to injure the fruit. *Parreira* probably does not need further testing since it appears to be similar to the *Tinta Cão* (see p. 43). Recommendations and comments with respect to *Tinta Cão* may also be applied to *Parreira*.

*Pe Agudo*: This variety has been tested as a red dry wine, as a red dessert wine, and as a sherry material. It is unsatisfactory for any of these purposes (table 73).



TABLE 73. COMPOSITION OF MUSTS AND WINES OF PE AGUDO

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color inten-sity*	Aver-age score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
IV:												
1946-58.....	3	3‡	Oct. 8	21.4	0.72	3.57	10.7	0.45	2.9	0.09	85	71.0
1946-58.....	1	1§	Sept. 25	19.9	0.75	3.50	18.6	0.49	11.3	0.10	55	72.5
1946-58.....	1	1	Sept. 25	20.4	0.51	3.50	22.1	0.47	1.5	0.04	11	77.0

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

‡ Red dry.

§ Red sweet.

|| Sherry.

*Perruno*: The present tests are the first reported for this variety, which is probably of Spanish origin. Perruno is a vigorous vine, and produces large crops. The five-year average for Davis is 10.2 tons per acre. The large, pulpy berries resemble those of Palomino. The composition of the fruit also resembles that of Palomino—high pH and very low acid. The variety was therefore tested for baked sherry. It has produced sound, sherry-type wines of fair quality but no better than, for example, those of Thompson Seedless. It is unlikely that the variety is of sufficiently high quality to try in Region III, and its composition in Region IV indicates that it need not be tried in Region V (table 74).

TABLE 74. COMPOSITION OF MUSTS AND WINES OF PERRUNO

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color inten-sity*	Aver-age score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
IV:												
1946-58.....	3	3	Oct. 25	22.6	0.46	3.93	19.6	0.32	5.9	0.03	12.0	75.7

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

*Petite Bouschet*: Some growers believe that Petite Bouschet is better than Alicante Bouschet. We have not found this to be true. It is not a vigorous grower and its production is low—a six-year average of only 4.5 tons per acre at Davis. The pH of the musts is high and the total acidity low. Finally, the wines are of only moderate color (table 75). This variety is not recommended for planting or for further trial.

TABLE 75. COMPOSITION OF MUSTS AND WINES OF PETITE BOUSCHET

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color inten-sity*	Aver-age score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
II:												
1935-41.....	2	2	Oct. 1	23.2	0.68	4.07	12.5	0.45	2.8	0.23	375	....
III:												
1935-41.....	1	1	Oct. 7	20.8	0.50	....	10.9	0.37	2.3	0.14	....	....
IV:												
1935-41.....	2	2	Oct. 3	20.8	0.55	3.69	10.4	0.48	2.6	0.15	250	....
1946-58.....	5	5	Oct. 11	22.3	0.73	3.59	10.5	0.60	3.0	0.13	243	72.8
V:												
1935-41.....	1	1	Sept. 4	23.0	0.58	....	12.7	0.44	2.7	0.15	....	....

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

*Petite Verdot*: This variety is one of many used for producing red wines in the Bordeaux region of France. We had not studied it in detail until the years covered in this report. It is only a fair producer. In six years at Davis it averaged 3.5 tons per acre, with a maximum of 5.5. At Oakville, with cane pruning in 1958, it produced 5.6 tons per acre as against 3.7 for spur pruning. Its musts have good acidity, but only moderate sugar (table 76). The flavor is not distinctive. We are unable to recommend it for further trials.

TABLE 76. COMPOSITION OF MUSTS AND WINES OF PETITE VERDOT

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color inten-sity*	Aver-age score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
I:												
1935-41.....	1	1	Oct. 16	23.5	0.70	....	12.0	0.50	3.4	0.12	....	....
1946-58.....	3	4	Oct. 7	22.1	0.93	3.38	10.7	0.80	3.4	0.11	178	76.1
IV:												
1935-41.....	5	6	Sept. 16	23.2	0.63	3.44	10.9	0.52	2.9	0.17	400	....
1946-58.....	5	5	Sept. 16	21.9	1.03	3.36	10.2	0.52	3.2	0.16	285	71.7

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

*Pepperella*: Although this variety has been in California for many years, it has never been whole-heartedly recommended either by Bioletti or Hilgard. Amerine and Winkler (1944) believed that it would be best in the cooler parts of Region IV and perhaps would reach its best quality in Region

III. In the experiments made since World War II, it has been tested in Regions I, IV, and V.

Peeverella is an excellent producer. In eight years at Davis it has averaged 7.3 tons per acre, with a maximum of 12.3. At Oakville during a four-year period it had an average yield of 6.8 tons per acre. It is a variety of well-balanced composition, either in Region I or in Region IV, being especially notable for maintaining a rather low average pH value. The wines have also been reasonably well balanced, but unfortunately, because they have never had a very distinctive flavor, they are difficult to recognize. Since the French Colombard equals or excels Peeverella in most characteristics, it is unlikely that the latter will find a place, at least on any large scale, in California plantings. It is not recommended for further trials nor for planting by anyone except a grower who is interested in trying some variety other than the French Colombard for white table wine in Regions III or IV. Analytical data are given in table 77.

TABLE 77. COMPOSITION OF MUSTS AND WINES OF PEVEERELLA

Region and years	No. of years sam- ples taken	No. of sam- ples	Average date of harvest	Must			Wine					
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†
				degrees	gm/ 100cc		per cent vol.	gm/ 100cc	gm/ 100gm	gm/ 100cc		
I:												
1946-58.....	5	5	Oct. 5	22.9	0.77	3.30	13.3	0.77	2.6	0.04	9.6	76.0
III:												
1935-41.....	1	2	Oct. 6	24.1	0.53	3.35	13.5	0.59	2.9	0.05	17.0	....
IV:												
1935-41.....	7	10	Sept. 17	23.7	0.79	3.29	12.5	0.54	2.5	0.04	19.0	....
1946-58.....	6	9	Sept. 28	21.2	0.78	3.33	11.9	0.73	2.6	0.03	16.6	74.3
V:												
1946-58.....	4	6	Sept. 8	22.3	0.93	3.37	12.0	0.78	2.9	0.03	7.1	74.6

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

*Pfeffer*: This variety was extensively tested in Regions I and III in the pre-war period, and has been tested in Region IV since World War II. Pfeffer is a late-ripening variety; consequently it was difficult to get mature grapes from Region I, even though they were harvested at an average date as late as October 10. The fruit was also rather light in color, and there was some doubt that it would obtain a market. Production has been poor—an average of 3.6 tons per acre at Davis (four-year period) and Oakville (five-year period), with a maximum of 4.2 at Davis. Pfeffer was expected to ripen properly in Region IV, where it was hoped that the distinctive flavor would recommend the variety if the must balance was suitable. The musts do retain a fair acidity, but the pH is rather high in Region IV. Furthermore, the wines are flat, and very low in color. Although the wines have had a very distinctive



aroma, they have not been appreciated by any of the panels, and the scores have been low. Since it is a rather small producer, Pfeffer probably will not find a place in California, and no further plantings are recommended. Analytical data are given in table 78.

TABLE 78. COMPOSITION OF MUSTS AND WINES OF PFEFFER

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Average score†
				degrees	gm/ 100cc		per cent vol.	gm/ 100cc	gm/ 100gm	gm/ 100cc		
I:												
1935-41.....	6	11	Oct. 10	20.3	1.07	3.06	10.6	0.67	2.5	0.12	131	....
III:												
1935-41.....	1	1	Sept. 22	24.2	0.78	3.15	13.4	0.63	2.8	0.07	245	....
IV:												
1946-58.....	7	7	Oct. 8	23.0	0.87	3.41	11.2	0.55	3.2	0.12	107	71.1

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

*Pinot gris*: This variety, not previously tested in California in so far as we know, has now been tested in Regions I and IV. Its greatest defects are its weak growth, exceedingly small production, and very early ripening. Average production of mature vines at Oakville during a three-year period was only 2.6 tons per acre. With the very small crops in Region I, harvest had been completed on September 10. The musts from this region actually had a higher sugar content than did those from Region IV, where the crop was higher, and was picked on September 8. In northern Italy, Cosmo and Polsinelli (1959a) found the wine in 22 samples to have a moderate acidity (0.49 to 0.77 gm per 100 cc; average, 0.63).

Because of the color of its fruit, *Pinot gris* produces somewhat darker white wine than desirable. The wine has a good *Pinot* flavor, but not any more distinctive than that of other, similar varieties. Consequently, there

TABLE 79. COMPOSITION OF MUSTS AND WINES OF PINOT GRIS

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†
				<i>degrees</i>	<i>gm/ 100cc</i>		<i>per cent vol.</i>	<i>gm/ 100cc</i>	<i>gm/ 100gm</i>	<i>gm/ 100cc</i>		
I: 1946-58.....	4	4	Sept. 10	24.1	0.71	3.25	13.2	0.76	3.0	0.02	9.8	76.4
IV: 1946-58.....	4	4	Sept. 8	19.9	0.77	3.27	10.6	0.58	2.4	0.02	22.0	73.9

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

is no place for the variety in the California industry at present, except perhaps in a very limited area with very cold climatic conditions—no warmer than the coolest part of Region I at any time. No further trials with this variety seem necessary. Analytical data are given in table 79.

*Pinot Pernand:* This strain of Pinot noir has been tested in northern California for many years. It has slightly less color than the best clones of Pinot noir, and for this reason alone it should not be planted in the state at present. It has characteristics similar to those of the Pinot noir—moderate acidity in the must when the grapes are picked early enough, but low acidity in the wines and generally low color. At Davis and Oakville its production has been the same as that of Pinot noir. If the variety is not picked so that it gets at least 12 per cent of alcohol, it does not produce wines of the best quality; on the other hand, when it is ripened so that it does get 12 per cent of alcohol, under California climatic conditions it is frequently too low in

TABLE 80. COMPOSITION OF MUSTS AND WINES OF PINOT PERNAND

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color inten-sity*	Aver-age score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
I:												
1935-41.....	1	1	Sept. 10	25.8	0.82	3.61	14.7	0.47	3.3	0.12	310	....
1946-58.....	3	3	Sept. 22	23.9	0.79	3.40	12.4	0.60	3.0	0.08	79	76.0
III:												
1935-41.....	1	1	Aug. 26	22.2	1.11	3.34	11.0	0.41	2.8	0.13	156	....
IV:												
1935-41.....	5	5	Aug. 28	22.5	0.75	3.46	10.6	0.41	2.7	0.08	52	....
1946-58.....	7	10	Sept. 18	22.3	0.81	3.45	10.9	0.58	3.0	0.07	80	74.0

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.  
† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

total acidity. Consequently the wines are very flat and difficult to ferment or to keep from spoiling. No further testing of this variety seems necessary. Analytical data are given in table 80.

*Pinot St. George:* This variety is of unknown origin. It is inferior to Pinot noir and even to Pinot Pernand and Meunier in everything except production (Amerine and Winkler, 1944). It is a moderate producer—from 4 to 7.5 tons per acre at Davis. The fruit is very subject to bunch rot in areas of early rainfall, which limits its utility in the more humid sections of Regions I and II. The wines are rather variable in composition, but generally tend to have a higher pH than those of Pinot noir, and the acidities are sometimes quite low. The fermentations are generally satisfactory, however, and the wines

have a pleasing color; but they are naturally rather flat especially when they occasionally undergo too pronounced a malo-lactic fermentation. Wines of Pinot St. George are occasionally mistaken for those of Pinot noir (Amerine, 1949). However, in spite of the variety's good production and good color, very few of its wines have been of more than passing interest. In fact, it is doubtful whether the variety would have survived this long were it not for the high demand for Pinot wines and the small amount of true Pinot noir available in the state. Certainly no further tests seem necessary, and the question is raised whether present plantings might be more profitably converted to varieties of higher quality. Analytical data are given in table 81.

TABLE 81. COMPOSITION OF MUSTS AND WINES OF PINOT SAINT GEORGE

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color intensity*	Average score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
I:												
1935-41.....	2	2	Oct. 8	22.9	0.55	3.60	13.1	0.45	2.6	0.13	203	....
1946-58.....	2	2	Oct. 5	22.7	0.95	3.30	11.7	1.00	3.2	0.16	169	74.3
II:												
1935-41.....	1	1	Oct. 7	25.0	0.60	3.60	13.2	0.50	2.9	0.22	400	....
1946-58.....	2	2	Oct. 10	22.5	0.81	3.40	11.4	0.52	3.1	0.12	280	72.0
III:												
1935-41.....	5	6	Sept. 19	24.8	0.45	3.54	12.9	0.43	2.6	0.11	330	....
1946-58.....	4	5	Sept. 15	22.3	0.71	3.56	11.6	0.58	3.1	0.14	247	74.9
IV:												
1935-41.....	7	20	Sept. 17	22.0	0.70	3.68	11.2	0.48	2.7	0.08	116	....
1946-58.....	3	6	Sept. 23	20.5	0.63	3.57	10.6	0.65	2.8	0.08	108	74.3

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

*Preto Manteudo:* This variety was first planted at Davis in 1934. Since it ripens very late it is obviously more desirable for dessert wines than for table wines. The data are indicated in table 82. It is only a moderate producer—

TABLE 82. COMPOSITION OF MUSTS AND WINES OF PRETO MANTEUDO

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color intensity*	Average score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
IV:												
1946-58.....	4	4	Oct. 15	20.9	0.61	3.50	19.0	0.40	10.6	0.06	57	73.8

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.



up to 5 tons per acre at Davis, with an average of 3. However, even when the grapes were picked as late as October 15, the musts had only a moderate sugar content and the resulting red sweet wines have not been impressive. Since some of them have been aged for several years and still have not developed any particular character, it is believed that this variety does not hold much interest, even as a dessert wine grape, under California conditions. It is doubtful if further testing should be done. Analytical data in table 82 constitute the first report on this variety.

*Prosecco*: This variety was imported to California from Italy in 1939, by Olmo. It has been tested in Regions II and IV. In the single trial in Region II, it ripened extremely poorly, had a rather high pH in relation to maturity of the fruit, and was very low in sugar. In Region IV it tends to overcrop and have a very high pH. The variety appears to have no place under California conditions. Analytical data are given in table 83.

TABLE 83. COMPOSITION OF MUSTS AND WINES OF PROSECCO

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color inten-sity*	Aver-age secret†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
II: 1946-58.....	1	1	Oct. 5	16.8	0.75	3.50	9.4	0.68	2.3	0.02	12.0	70.5
IV: 1946-58.....	3	3	Oct. 12	20.1	0.71	3.67	11.2	0.38	2.3	0.03	9.3	71.5

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

For a description of Prosecco, see Cosmo and Polsinelli (1958a). Their analyses of 37 musts show sugar contents of 15.5 to 22.4 (average, 19.2); total acidity ranging from 0.41 to 0.77 gm per 100 ml (average, 0.52); and pH ranging from 2.71 to 3.98 (average, 3.42). Because of the moderate alcohol, Prosecco was recommended by these workers for sweet sparkling wine. We cannot agree with this recommendation.

*Red Traminer*: This is the nonspicy form of the Gewürztraminer. In other respects it is similar in production and vegetative characteristics. Only the aromatic form merits consideration for planting in California. For analytical data see table 84.

TABLE 84. COMPOSITION OF MUSTS AND WINES OF RED TRAMINER

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color intensity*	Average score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
II:												
1935-41.....	1	1	Oct. 4	21.0	0.39	3.27	11.7	0.52	1.9	0.04	25.0	....
IV:												
1934-41.....	7	10	Sept. 6	23.0	0.63	3.52	12.2	0.43	2.4	0.04	26.1	....
1946-58.....	4	6	Sept. 28	24.5	0.64	3.67	13.7	0.54	2.5	0.03	23.0	74.8

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

*Saint Émilion*: This variety (also called Trebbiano and Ugni blanc) was not recommended by any of the previous Experiment Station investigators, and still is not recommended for California conditions.

Its wines are low in acidity, particularly in the regions tested (table 85),

TABLE 85. COMPOSITION OF MUSTS AND WINES OF SAINT ÉMILION

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color intensity*	Average score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
II:												
1935-41.....	2	2	Oct. 17	24.7	0.77	3.15	14.1	0.56	3.3	0.05	25.0	....
III:												
1935-41.....	7	8	Sept. 28	21.0	0.65	3.27	11.6	0.53	2.3	0.05	21.0	....
1946-58.....	2	2	Sept. 15	19.8	0.88	3.35	10.1	0.73	2.6	0.03	16.5	74.0
IV:												
1935-41.....	5	7	Oct. 6	22.6	0.62	3.57	11.5	0.41	2.3	0.04	24.0	....
1946-58.....	1	1	Oct. 5	23.6	0.62	3.70	13.9	0.38	2.3	0.03	30.0	71.5
V:												
1935-41.....	6	6	Aug. 27	20.4	0.54	3.69	11.1	0.44	2.5	0.05	15.0	....

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

and almost completely neutral in character. If it were not for the fact that it is a high producer (up to 9.3 tons per acre at Davis) and is easy to grow and harvest (very long, large clusters), it would certainly not have lasted so long in the state.

In France, this variety is often used for a dry vermouth base, and it is, of course, the leading variety in the very cool Cognac district where it makes a good distilling wine. It is also used for white Chianti, but the quality of these wines is generally very low.

The recommendations of earlier investigators have been substantiated by the tests reported here, and no further testing or planting in California is recommended. Analytical data are given in table 85.

*Saint Macaire*: This is a variety of the Bordeaux complex, but it is not particularly vigorous, and is only a moderate producer—a six-year average of 4.1 tons per acre at Davis, with a maximum of 6.2.

The wines are reasonably well balanced with respect to sugar and acidity, but they do not have a distinctive flavor, and have not scored above average in our tests. The young wines are rather full-bodied and slightly rough.

Saint Macaire is not recommended for planting in California. Growers who now produce it may best use it as a blending variety for color. Analytical data are given in table 86.

TABLE 86. COMPOSITION OF MUSTS AND WINES OF SAINT MACAIRE

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†
				degrees	gm/ 100cc		per cent vol.	gm/ 100cc	gm/ 100gm	gm/ 100cc		
II:												
1935-41.....	7	8	Oct. 1	22.5	0.73	3.30	12.1	0.63	3.0	0.20	1,029	....
IV:												
1935-41.....	7	13	Sept. 19	22.0	0.72	3.54	10.6	0.49	2.8	0.17	354	....
1946-58.....	2	2	Sept. 30	22.4	0.80	3.35	11.2	0.78	3.4	0.19	777	74.8
V:												
1935-41.....	4	4	Aug. 31	22.6	0.60	3.39	11.8	0.49	2.9	0.17	350	....

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

*Sangiovetto*: The traditional variety of Tuscany, Sangiovetto was tested for a long while in California without attaining any recognition from the growers. Amerine and Winkler (1944) thought this to be the result of low production. The clone of the variety that is available in California is somewhat irregular in production. However, the maximum yield in seven years at Davis was 8.3 tons per acre. At Oakville there has been one very large crop, 7.4 tons per acre, and a three-year average of 4.4 tons. A number of tests have been made with very long pruning in an attempt to secure moderate crops from this variety, but they have been only partially successful.

The variety has a high total acidity, ripens late in the season, and so far has produced only average or even below-average quality wines in Regions I and IV. On the credit side is the fact that its fruit is very clean and easy to ferment. However, it does not have good color, and the musts are unbalanced. Further plantings of this particular clone should not be made in California. Analytical data are given in table 87.



TABLE 87. COMPOSITION OF MUSTS AND WINES OF SANGIOVETO

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color intens-ity*	Aver-age score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
I:												
1946-58.....	3	3	Oct. 5	23.0	1.03	3.17	11.8	0.92	3.6	0.21	141	75.5
IV:												
1935-41.....	7	13	Sept. 24	23.9	0.84	3.53	11.8	0.50	3.1	0.17	105	.....
1946-58.....	8	8	Sept. 25	21.5	1.20	3.30	9.9	0.87	3.5	0.11	162	72.6

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

*Sauvignon vert*: This does not appear to be a relative of the Sauvignon blanc nor, indeed, even a Sauvignon-like variety. Furthermore, it is not nearly so good a variety as the Sauvignon blanc. Many winemakers like it, however, because it is a good producer (seven-year average, 5 tons per acre; maximum, 8.4, at Davis) and has a distinctive, slightly muscat-like aroma. It is therefore widely planted in California.

The clusters are very subject to attack by bees and mold, and in years of early rainfall the Sauvignon vert fruit is among the first to disintegrate on the vines. Furthermore, the musts are low in acidity, high in pH, and often irregular in fermentation. They produce wines that are never of more than

TABLE 88. COMPOSITION OF MUSTS AND WINES OF SAUVIGNON VERT

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color intens-ity*	Aver-age score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
I:												
1935-41.....	7	19	Oct. 13	21.7	0.62	3.36	12.0	0.48	2.2	0.04	18.6	.....
1946-58.....	3	3	Oct. 12	18.4	0.89	3.23	10.2	0.84	2.5	0.03	8.3	74.0
II:												
1935-41.....	7	23	Sept. 29	23.2	0.50	3.52	12.7	0.44	2.4	0.03	18.5	.....
1946-58.....	2	2	Sept. 30	22.4	0.52	3.55	12.8	0.57	2.2	0.02	8.5	74.2
III:												
1935-41.....	7	20	Sept. 21	22.3	0.49	3.59	12.2	0.47	2.4	0.04	15.0	.....
1946-58.....	5	10	Sept. 22	21.7	0.58	3.51	12.2	0.57	2.6	0.02	9.6	73.9
IV:												
1935-41.....	6	11	Sept. 24	23.2	0.56	3.72	11.6	0.42	2.6	0.03	30.9	.....
1946-58.....	2	5	Sept. 20	24.0	0.58	3.98	13.5	0.54	2.9	0.09	41.0	72.5
V:												
1935-41.....	6	14	Aug. 20	23.1	0.48	3.76	11.9	0.42	2.7	0.04	18.6	.....

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

ordinary interest. As a matter of fact, the Sauvignon vert musts and wines appear to have some of the characteristics of a dry muscat wine—flat, with a bitter after-taste.

From a viticultural and enological point of view, this variety should not be planted in California. Analytical data are given in table 88.

*Steinschiller*: This variety has been tested by a number of investigators in California. It has not been recommended for planting because its late ripening results in very low total acidity and high pH. The data in table 89

TABLE 89. COMPOSITION OF MUSTS AND WINES OF STEINSHILLER

Region and years	No. of years sam- ples taken	No. of sam- ples	Average date of harvest	Must			Wine					
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†
				degrees	gm/ 100cc		per cent vol.	gm/ 100cc	gm/ 100gm	gm/ 100cc		
IV:												
1935-41.....	6	6	Oct. 8	21.8	0.44	3.54	12.5	0.46	2.2	0.05	15.3	....
1946-58.....	3	3	Oct. 2	20.5	0.55	3.43	11.4	0.57	3.3	0.04	8.7	74.5

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

indicate that this evaluation is correct; consequently, there is little reason why the variety should be further tested in the state. It is only a fair producer, with a seven-year average of 4.6 tons per acre.

*Talia*: This white variety has good production but, as indicated in table 90, its fruit does not ripen well at Davis, even when picked in mid-October. Consequently, it produces wines of very low alcohol content and of no particular interest. No further trials nor plantings of this variety are recommended.

TABLE 90. COMPOSITION OF MUSTS AND WINES OF TALIA

Region and years	No. of years sam- ples taken	No. of sam- ples	Average date of harvest	Must			Wine					
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†
				degrees	gm/ 100cc		per cent vol.	gm/ 100cc	gm/ 100gm	gm/ 100cc		
IV:												
1946-58.....	4	4	Oct. 13	16.9	0.93	3.23	8.9	1.10	2.3	0.04	9.8	70.3

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

*Tamarez*: This variety, like *Talia*, does not ripen well at Davis, even when harvested in mid-October (table 91). The wines have little character, and the variety is not recommended for further trials nor plantings in California.

TABLE 91. COMPOSITION OF MUSTS AND WINES OF TAMAREZ

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color inten-sity*	Aver-age score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
IV: 1946-58.....	5	5	Oct. 15	18.1	0.71	3.38	10.1	0.64	2.2	0.03	8.4	73.3

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

*Tannat*: This variety has been in California for many years and has been extensively tested by many growers as well as by the University. Amerine and Winkler (1944) gave it a limited recommendation for Regions I, II, and III. They did not recommend it for Regions IV and V. The production is only moderate—3.6 tons per acre average over a seven-year period at Davis and a four-year period at Oakville. Cane pruning would doubtless increase that figure. Analytical data are shown in table 92.

TABLE 92. COMPOSITION OF MUSTS AND WINES OF TANNAT

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color inten-sity*	Aver-age score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
I:												
1935-41.....	5	5	Oct. 8	21.7	0.88	3.11	11.7	0.67	2.6	0.18	340	...
1946-58.....	6	7	Oct. 6	23.8	1.08	3.17	11.9	0.94	3.5	0.19	474	75.4
II:												
1946-58.....	1	1	Oct. 15	18.6	1.71	2.80	8.3	1.18	3.1	0.15	270	72.5
III:												
1935-41.....	5	6	Sept. 30	24.1	0.78	3.17	12.5	0.62	2.9	0.24	553	...
IV:												
1935-41.....	5	6	Sept. 15	23.4	0.89	3.22	11.4	0.56	2.9	0.17	560	...
1946-58.....	4	4	Sept. 22	22.3	1.06	3.25	10.7	0.83	2.9	0.20	271	73.0
V:												
1935-41.....	4	4	Aug. 25	23.7	0.69	3.20	12.3	0.62	3.0	0.20	437	...

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

The variety is high in natural total acidity and relatively low in pH. Nevertheless, its fruit ripens very well, resulting generally in a good alcohol content. The aroma, while not unpleasant, is very fruity in most cases, and not



particularly distinctive in the same sense as that, for example, of Cabernet Sauvignon. Furthermore, the rather high tannin content leads to wines that are astringent. Astringency and slowness to age have been previously noted in this variety, and are among the reasons for its not being more extensively planted in California. The wines, however, are of excellent color. Although Tannat is a useful variety, it is probably not one that can be generally recommended for planting in this state. Its wines would be very useful in blending, especially with those produced in the San Joaquin Valley, but this is scarcely a sufficient reason for planting wine grape varieties in the coast counties of California. Somewhat reluctantly, therefore, we do not recommend Tannat for further planting or trials in California.

*Teinturier*: This variety is one of low vigor and production. It is one of the few *Vitis vinifera* varieties with red juice, but it cannot be used as a source of color because it produces only moderately colored wines (table 93). While its wines are fruity, its lack of production and color prevents our recommending it.

TABLE 93. COMPOSITION OF MUSTS AND WINES OF TEINTURIER

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†
				degrees	gm/ 100cc		per cent vol.	gm/ 100cc	gm/ 100gm	gm/ 100cc		
IV: 1946-58.....	4	4	Sept. 30	20.8	0.86	3.35	10.4	0.67	3.0	0.11	90	74.3

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

*Tinta Miuda*: This is another Portuguese variety imported by Olmo. Over a four-year period at Davis, production has varied from 2.4 to 8.1 tons per acre. It is a very late-ripening variety, and has produced musts useful only for red dessert wines (table 94). The color is fair and the tannin content low. Possibly this variety should be tested further, but commercial plantings are not recommended at this time.

*Tinta Mole*: This is a late-ripening variety with musts suitable for dessert wine. It has a low color, however, and does not appear to be of any particular interest for further plantings (table 94). Further University trials may, however, be desirable.

*Tinta Pinheira*: This variety seems to be similar to Tinta Cão, and of no greater interest than the latter for California planting. In fact, its production has been lower than that of Tinta Cão at Davis. As indicated in table

94, it ripens late, does not have a high sugar content, and produces wines very low in color and tannin. No further trials are recommended for this variety.

TABLE 94. COMPOSITION OF MUSTS AND WINES OF TINTA MIUDA, TINTA MOLE, AND TINTA PINHEIRA

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color inten-sity*	Aver-age score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
Tinta Miuda												
IV:												
1946-58.....	3	3	Oct. 25	23.2	0.58	3.63	20.2	0.40	12.5	0.07	157	76.5
Tinta Mole												
IV:												
1946-58.....	3	3	Oct. 13	21.8	0.67	3.50	17.8	0.55	10.5	0.12	109	75.8
Tinta Pinheira												
IV:												
1946-58.....	5	5	Oct. 25	19.7	0.84	3.62	18.7	0.52	10.4	0.06	71	73.1

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

*Trincadeira*: This is a white variety of moderate production. It has been tested only in Region IV where it was very late in ripening, and had a fairly high pH and moderate acidity at time of picking (table 95). It has produced standard but not outstanding white dessert wines rather neutral in character. Further testing of this variety in California, for the production of white dessert wine, seems unnecessary.

TABLE 95. COMPOSITION OF MUSTS AND WINES OF TRINCADEIRA

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color inten-sity*	Aver-age score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
IV:												
1946-58.....	4	4	Oct. 22	22.2	0.66	3.80	19.3	0.51	12.6	0.02	10.2	74.6

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

*Trousseau*: This variety, known in California for many years, was tested by Hilgard and others and was also studied by Amerine and Winkler (1944). The earlier investigations indicated that it was a variety solely for the production of dessert wines. However, the lack of color in the wines does not recommend it to California growers.

It is a good producer, especially on very old vines. Vines at Davis averaged 6.5 tons per acre over a 13-year period, with a maximum of 9.7. However, clusters are small and are subject to bunch rot, especially in a year of large crop or from irrigated vineyards. For this reason alone, the variety could not be recommended for further plantings in California. In addition, its tendency to raisin and its very low color indicate further why it has gradually disappeared from our plantings.

The composition of the fruit (table 96) shows that it does achieve a high

TABLE 96. COMPOSITION OF MUSTS AND WINES OF TROUSSEAU

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color inten-sity*	Aver-age score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
I:												
1935-41.....	2	2	Oct. 2	26.5	0.52	3.81	17.0	0.43	12.0	0.06	214	....
IV:												
1935-41.....	6	17	Oct. 4	26.4	0.57	4.01	18.6	0.34	11.7	0.07	114	....
1946-58.....	9	19	Sept. 29	24.7	0.66	3.74	19.6	0.47	12.0	0.05	93	74.3
V:												
1935-41.....	6	15	Aug. 25	25.7	0.48	3.84	18.5	0.36	11.5	0.08	79	...
1946-58.....	5	9	Sept. 5	23.0	0.71	3.53	18.4	0.48	12.3	0.05	94	74.7

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

degree of sugar even early in the season, but this is accompanied by a high pH, and the wines tend to spoil easily unless they are carefully handled. Since much of the fruit arrives with considerable rot and also contains acetic organisms, sound wines are sometimes difficult to produce from this variety. It has survived in other parts of the world because of its high sugar content, but this is not enough to recommend it for planting in California. No further trials nor plantings of this variety are recommended.

*Valdepeñas*: This variety was much favored by Bioletti (1908) for production of table wine in the interior valley. However, neither pre- nor postwar results have been good. The variety can be recommended on the basis of vigor and productivity (8.8 tons at Davis). Furthermore, the fruit ripens early in the season and is usually in good condition at the time of harvesting. (The dates of ripening for this variety in the different regions of California are an almost perfect example of the effect of climate in this state.)



TABLE 97. COMPOSITION OF MUSTS AND WINES OF VALDEPEÑAS

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color inten-sity*	Aver-age score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
I:												
1935-41.....	6	8	Oct. 10	23.0	0.56	3.50	12.4	0.46	2.6	0.19	225	....
II:												
1935-41.....	7	11	Oct. 4	22.5	0.62	3.48	12.3	0.51	2.7	0.19	264	....
IV:												
1935-41.....	7	26	Sept. 18	23.2	0.54	3.61	11.7	0.48	2.8	0.17	249	....
1946-58.....	9	12	Sept. 13	22.0	0.73	3.41	12.2	0.60	3.1	0.11	207	73.9
V:												
1935-41.....	1	1	Aug. 25	20.4	0.54	3.42	10.6	0.57	2.6	0.17	121	....
1946-58.....	3	3	Aug. 26	22.6	0.50	3.60	11.6	0.52	2.9	0.15	151	72.8

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

The chief defects of the variety, as indicated in table 97, are its low acidity and relatively high pH. This is particularly evident in Region V, where the wines have been very flat and lacking in character. Because of its high production, it is possible that Valdepeñas could provide distilling material early in the season if no other varieties were available. However, the surplus table grapes generally provide such material.

Valdepeñas is not recommended for planting as a red wine grape in California, and no further trials are planned.

*Verdea*: This is a variety of low production—the average at Davis, only 3.5 tons per acre.

It ripens fairly late in the season, but the acidity has been fairly well maintained and the wines have not been unduly flat in character (table 98). However, the variety cannot be recommended because the wines are very

TABLE 98. COMPOSITION OF MUSTS AND WINES OF VERDEA

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color inten-sity*	Aver-age score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
IV:												
1946-58.....	6	6	Oct. 1	21.9	0.73	3.48	12.8	0.65	2.5	0.02	8.8	72.9

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

neutral in character and would therefore not compete favorably with the other, more readily available neutral varieties, such as the Thompson Seedless.

*Wälschriesling*: Information on this variety in both Regions I and IV is insufficient for a fair evaluation of its potentialities in California. A good recent description of Wälschriesling is that of Cosmo and Polsinelli (1955*b*). Their must analyses (42 samples) are variable: sugar, 15.3 to 26.2 per cent (average, 19.3); total acid, 0.40 to 0.82 (average, 0.56). The wines were of low body and slightly bitter (tannins, 0.004 to 0.15, average, 0.04, for 59 wines). This may have been due to fermenting some samples on the skins too long. These authors consider Wälschriesling to be low in vigor, good in productivity and quality of fruit. We believe this appraisal to be correct. The six-year average at Davis was 4.1 tons per acre, with a maximum of 5.3. At Oakville, the three-year average was 3.9 tons per acre, with a maximum of 5.7.

The composition of the variety is only moderately favorable for white table wines (table 99). The sugar is adequate and the acidity is slightly below

TABLE 99. COMPOSITION OF MUSTS AND WINES OF WÄLSCHRIESLING

Region and years	No. of years sam- ples taken	No. of sam- ples	Average date of harvest	Must			Wine					
				Ball- ing	Total acid	pH	Alco- hol	Fixed acid	Ex- tract	Tan- nin	Color inten- sity*	Aver- age score†
				<i>degrees</i>	<i>gm/ 100cc</i>		<i>per cent vol.</i>	<i>gm/ 100cc</i>	<i>gm/ 100gm</i>	<i>gm/ 100cc</i>		
1946-58.....	3	3	Sept. 25	22.0	0.64	3.30	12.7	0.69	2.4	0.03	13.7	74.8
1935-41.....	7	7	Sept. 3	22.4	0.56	3.42	11.9	0.43	2.0	0.03	16.0	....
1946-58.....	4	4	Sept. 20	21.6	0.66	3.32	12.0	0.61	2.4	0.02	15.5	74.3

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.

† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

average, particularly in Region IV. The fruit matures early. The wines are pleasant in character, slightly above average, but not highly distinctive. For this reason, the variety is not recommended for further plantings or trials. We realize that the variety is an important one in northern Italy and in Yugoslavia, but the wines that we have tasted from these regions have only confirmed our opinion that Wälschriesling is capable of producing standard or slightly above standard quality wine, but not the finest.

*White Elbling*: At Davis this variety has shown rather low vigor and production, with a maximum yield of only 3.7 tons per acre during a five-year period. It ripens in mid-season (table 100), with moderate acidity. The wines

are moderately distinctive and of good quality. Perhaps the variety should be tested in Region I or II, and an effort be made to find a higher-producing clone.

TABLE 100. COMPOSITION OF MUSTS AND WINES OF WHITE ELBLING

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color inten-sity*	Aver-age score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
IV: 1946-58.....	3	3	Sept. 18	19.9	0.74	3.50	10.8	0.67	2.3	0.02	13.3	76.3

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.  
† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.

*White Veltliner:* This variety has been tested in Regions II, III, and IV since World War II. It is a fairly good producer, with a six-year average at Davis of 5.1 tons per acre, and a maximum of 8.3. It can be overcropped, and then may not ripen. The wines have a reasonably good sugar-acid balance in Region II and a somewhat less desirable sugar-acid balance in Regions III and IV. At its best in Region II the variety produces a slightly piquant wine. The wines have not been of high quality, but fairly neutral in character. Consequently, this variety is not recommended for further trials or plantings in California. Analytical data are shown in table 101.

TABLE 101. COMPOSITION OF MUSTS AND WINES OF WHITE VELTLINER

Region and years	No. of years samples taken	No. of samples	Average date of harvest	Must			Wine					
				Ball-ing	Total acid	pH	Alco-hol	Fixed acid	Ex-tract	Tan-nin	Color inten-sity*	Aver-age score†
				degrees	gm/100cc		per cent vol.	gm/100cc	gm/100gm	gm/100cc		
II: 1946-58.....	2	3	Sept. 18	21.4	0.86	3.27	12.1	0.76	2.4	0.02	16.7	75.7
III: 1946-58.....	2	2	Sept. 30	24.3	0.69	3.45	13.5	0.47	3.6	0.02	9.5	73.0
IV: 1946-58.....	4	5	Sept. 11	22.7	0.66	3.42	12.5	0.62	2.5	0.04	15.0	73.1

\* Determined by means of color standards in a color comparator. The higher the figure, the greater the color intensity. Red wines are graded on a color scale of 100 to 400; white wines, on a scale of 10 to 50. Wines that grade above or below the scales indicated are too high or too low in color to be classified as typical red or white wines.  
† On a scale of 65 to 84, in which 70 to 77 includes standard wines, above 77 superior wines, and below 70, substandard or spoiled wines.



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